

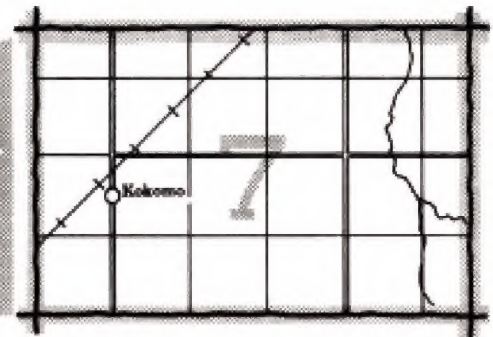
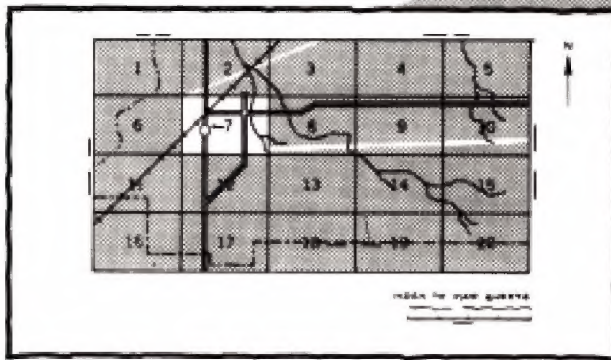
Soil Survey of **Benton County, Iowa**



United States Department of Agriculture, Soil Conservation Service
in cooperation with
Iowa Agriculture and Home Economics Experiment Station
Cooperative Extension Service, Iowa State University, and the
Department of Soil Conservation, State of Iowa

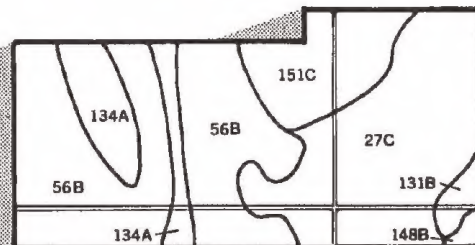
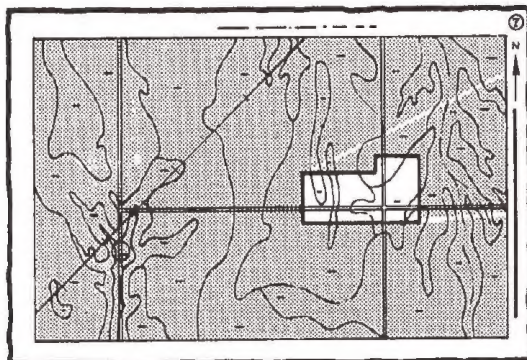
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

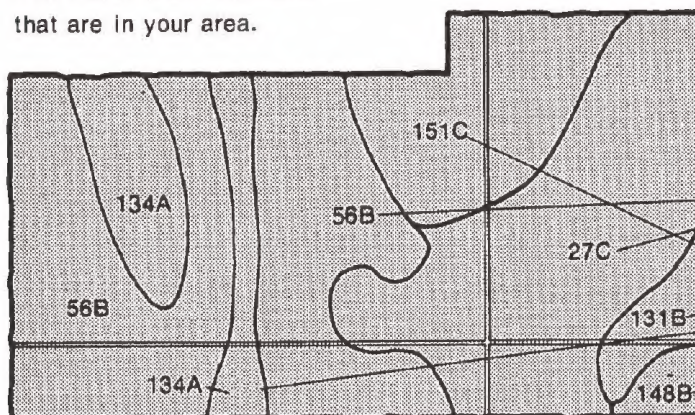


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.

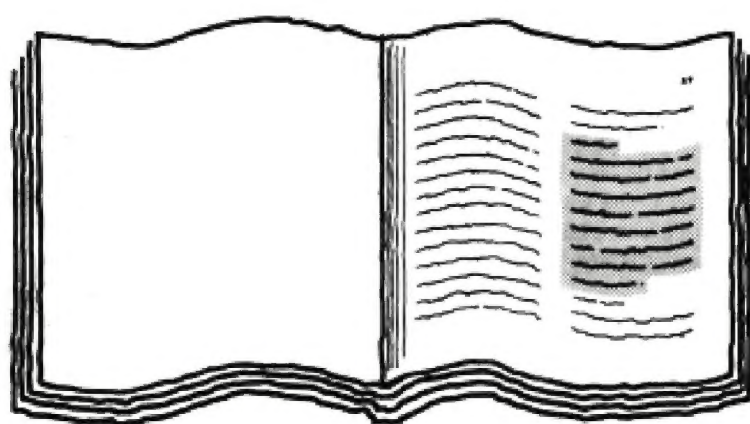


Symbols

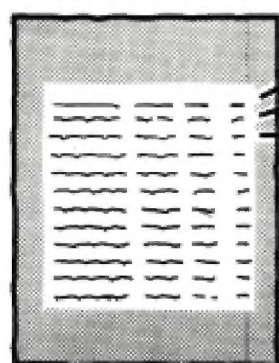
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

- 5.** Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.

[illegible]

- 6.** See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



Year	Abundance	Mortality
1970	100	10
1971	110	12
1972	120	15
1973	130	18
1974	140	20
1975	150	22
1976	160	25
1977	170	28
1978	180	30
1979	190	32
1980	200	35
1981	210	38
1982	220	40
1983	230	42
1984	240	45
1985	250	48
1986	260	50
1987	270	52
1988	280	55
1989	290	58
1990	300	60
1991	310	62
1992	320	65
1993	330	68
1994	340	70
1995	350	72
1996	360	75
1997	370	78
1998	380	80
1999	390	82
2000	400	85
2001	410	88
2002	420	90
2003	430	92
2004	440	95
2005	450	98
2006	460	100
2007	470	102
2008	480	105
2009	490	108
2010	500	110
2011	510	112
2012	520	115
2013	530	118
2014	540	120
2015	550	122
2016	560	125
2017	570	128
2018	580	130
2019	590	132
2020	600	135
2021	610	138
2022	620	140
2023	630	142
2024	640	145
2025	650	148
2026	660	150
2027	670	152
2028	680	155
2029	690	158
2030	700	160
2031	710	162
2032	720	165
2033	730	168
2034	740	170
2035	750	172
2036	760	175
2037	770	178
2038	780	180
2039	790	182
2040	800	185
2041	810	188
2042	820	190
2043	830	192
2044	840	195
2045	850	198
2046	860	200
2047	870	202
2048	880	205
2049	890	208
2050	900	210
2051	910	212
2052	920	215
2053	930	218
2054	940	220
2055	950	222
2056	960	225
2057	970	228
2058	980	230
2059	990	232
2060	1000	235
2061	1010	238
2062	1020	240
2063	1030	242
2064	1040	245
2065	1050	248
2066	1060	250
2067	1070	252
2068	1080	255
2069	1090	258
2070	1100	260
2071	1110	262
2072	1120	265
2073	1130	268
2074	1140	270
2075	1150	272
2076	1160	275
2077	1170	278
2078	1180	280
2079	1190	282
2080	1200	285
2081	1210	288
2082	1220	290
2083	1230	292
2084	1240	295
2085	1250	298
2086	1260	300
2087	1270	302
2088	1280	305
2089	1290	308
2090	1300	310
2091	1310	312
2092	1320	315
2093	1330	318
2094	1340	320
2095	1350	322
2096	1360	325
2097	1370	328
2098	1380	330
2099	1390	332
2100	1400	335

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1990	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Category	Sub-category	Value	Value	Value	Value	Value	Value
1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
2	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
3	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
4	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
5	1	1	1	1	1	1	1
	2	2	2	2	2	2	2

- 7.** Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1969-74. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1974. This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Benton County Soil and Water Conservation District. Funds appropriated by Benton County were used to defray part of the cost of this survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Typical landscape in the Fayette-Downs association. Fayette soils are on the upper part of slopes, and Lindley soils are on the lower part.

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Preface

This soil survey contains information that can be used in land-planning programs in Benton County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Soil Survey of **Benton County, Iowa**

United States Department of Agriculture
Soil Conservation Service

in cooperation with
Iowa Agriculture and Home Economics Experiment Station
Cooperative Extension Service, Iowa State University, and the
Department of Soil Conservation, State of Iowa

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BENTON COUNTY is in east-central Iowa (fig. 1). It is rectangular and is about 30 miles from north to south and 24 miles from east to west. It has a total area of 459,520 acres, or 720 square miles.

The county is about 67 percent cropland, 15 percent pastureland, 15 percent woodland, wasteland, and idle land, and 5 percent urban land. Corn for grain and seed, soybeans, cattle, and hogs are the principal farm products.

The area that became Benton County was acquired by the United States as a part of the Louisiana Purchase in 1803. The area was settled in 1839 and was organized as Benton County in 1846. In 1865 the population was 11,245. By 1900 it was 25,177. In 1970 the population of the county was 22,885, and the population of Vinton, the county seat, was 4,845.

Benton County is on a loess-covered glacial till plain. The soils in the dominantly gently sloping and moderately sloping areas formed in loess and till under prairie vegetation. The soils in the steeper areas and on the pahas formed in loess and till under trees.

General nature of the survey area

On the pages that follow is general information on natural resources, farming, drainage, relief, and transportation of the county.

Natural resources

Soil is the most important natural resource in the county. Crops and hogs and cattle for slaughter are marketable products derived from the soil.

Limestone is also an important natural resource. Several limestone quarries are in the northern part of the county.

In most of the county, the water supply is adequate for domestic use and livestock. Many flowing artesian wells are in the area around Belle Plaine. "Big Jumbo," a well known artesian well dug in Belle Plaine in 1886, flowed out of control for over a year before the flow could be stopped and the well sealed.

Farming

Because of the capability of the soils in Benton County and the climatic conditions, both crops and livestock are important to the economy. This has been true since the first years of settlement when grain was grown largely for subsistence and cattle were herded on the open range.

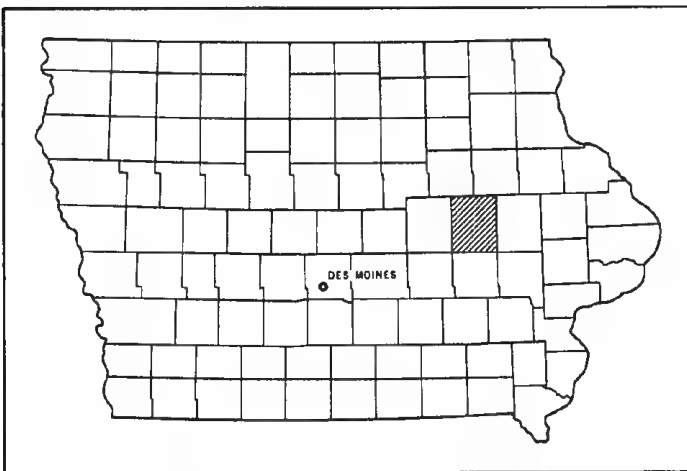


Figure 1.—Location of Benton County in Iowa.

Wheat was important in those early years but declined in importance because of insect pests and inadequate profits. Corn, which was also grown in the first years of settlement, gradually increased in importance to become the most important crop. Soybeans is the second most important crop.

Some steeper areas still have a forest cover. The others are used for pastureland and cropland.

In 1970 about 150,000 acres was in corn; 30,000 acres in oats; 76,000 acres in soybeans; 30,000 acres in hay; 78,000 acres in pasture; and about 79,000 acres in woodland, farmsteads, and wasteland.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Vinton in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 22 degrees F, and the average daily minimum temperature is 14 degrees. The lowest temperature on record, which occurred at Vinton on March 1, 1962, is -34 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred at Vinton on July 30, 1955, is 105 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 32.38 inches. Of this, 23 inches, or 72 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 5.80 inches at Vinton on August 5, 1968. Thunderstorms occur on about 41 days each year, and most occur in summer.

Average seasonal snowfall is 32 inches. The greatest snow depth at any one time during the period of record was 21 inches. On an average of 24 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 84 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average wind-speed is highest, 13 miles per hour, in April.

Drainage

Two major drainage systems, the Iowa River and the Cedar River, receive runoff. The Cedar River and its tributaries drain nearly 90 percent of the county. Prairie Creek, a major tributary of the Cedar River, drains much of the southern part of the county. The Iowa River, which flows across the southwest corner, drains about 10 percent of the county.

Relief

The highest areas in the county are located in Polk and Jackson townships and are 1,050 feet to 1,100 feet above sea level. The lowest areas are on bottom land along the Cedar River at the Benton-Linn County line and on the Iowa River bottom. The elevation of these areas is 700 feet to 750 feet above sea level.

The relief is stronger along the Cedar River and in the southern part of the county. It is less pronounced in the west-central part of the county.

Transportation

Two major highways extend across the county. U.S. Highway No. 30 traverses the southern half of the county. U.S. Highway No. 218 extends east and north across the county. Several state highways and hard surfaced county roads connect these major highways to the smaller communities. Most other roads are hard surfaced or are surfaced with crushed limestone or gravel.

Many towns are served by railroad lines that generally traverse the county in an east-west direction.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some

are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Association descriptions

1. Dinsdale-Kenyon-Tama association

Nearly level to strongly sloping, well drained and moderately well drained loamy and silty soils; on uplands

The characteristic landscape of this association is wide, gently sloping convex ridgetops and moderately sloping to strongly sloping side slopes. A well-developed network of drainageways is also characteristic.

The soils of this association formed in loess, glacial till, and loamy material or loess overlying glacial till (fig. 2).

This association occupies about 53 percent of the county. It is about 40 percent Dinsdale soils, 14 percent Kenyon soils, 8 percent Tama soils, and 38 percent soils of minor extent.

Dinsdale soils are gently sloping and moderately sloping. They are moderately well drained. Typically, the surface layer is very dark brown silty clay loam and is about 7 inches thick, except where eroded. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 33 inches thick. It is brown, friable silty clay loam in the upper part and brown and yellowish brown, firm loam in the lower part. The substratum is yellowish brown loam.

Kenyon soils are gently sloping to strongly sloping. They are moderately well drained. Typically, the surface layer is very dark brown loam and is about 11 inches thick, except where eroded. The subsurface layer is very dark grayish brown, brown, and dark brown loam about 7 inches thick. The subsoil is about 36 inches thick. It is brown, friable loam in the upper part, dark yellowish brown and yellowish brown, firm loam in the middle part, and mottled yellowish brown and grayish brown, firm loam in the lower part. The substratum is mottled grayish brown and yellowish brown, calcareous loam.

Tama soils are nearly level to moderately sloping. They are well drained. Typically, the surface layer is black silty clay loam and is about 8 inches thick, except where eroded. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 29 inches thick. The upper few inches is brown, and the rest is dark yellowish brown with some mottles. The substratum is yellowish brown silt loam in the upper part and yellowish brown sandy loam and loam in the lower part.

Of minor extent are the well drained Aredale soils and moderately well drained Bassett soils on side slopes, the poorly drained Colo soils in drainageways, the somewhat poorly drained Ely soils on alluvial fans on foot slopes, the somewhat poorly drained Klinger soils at the heads of upland drainageways and on foot slopes, and the somewhat poorly drained Muscatine soils on upland divides and slightly concave foot slopes.

Most of the association is cultivated. Poorly drained swales and waterways are used for permanent pasture. Most trees are in groves or windbreaks near farm buildings.

These soils are suited to all cultivated crops commonly grown in the county. The main enterprises are growing corn and soybeans for cash crops and feeding hogs and beef cattle. The main concerns of management are controlling erosion, improving drainage along waterways, and maintaining tilth and fertility.

2. Muscatine-Garwin-Tama association

Nearly level to moderately sloping, well drained to poorly drained silty soils; on uplands

The characteristic landscape of this association is broad upland flats, long gentle slopes, slightly rounded

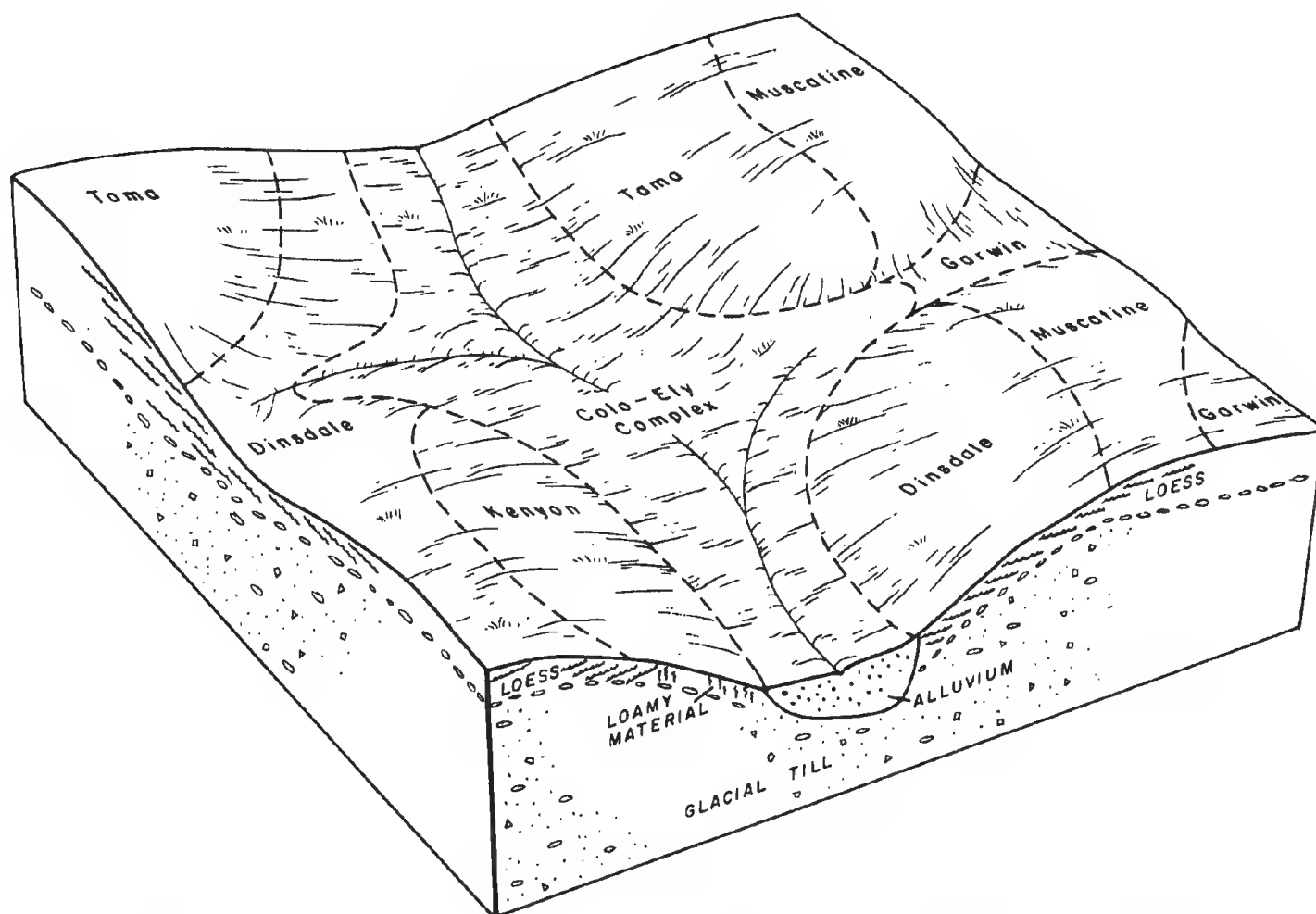


Figure 2.—Relationship of slope and parent material to the soils of the Dinsdale-Kenyon-Tama association and the Muscatine-Garwin-Tama association.

hills, and a well developed network of drainageways (fig. 2). In some areas hillsides are moderately sloping and have short slopes.

The soils of this association formed in loess (fig. 2).

This association occupies about 7 percent of the county. It is about 54 percent Muscatine soils, 16 percent Garwin soils, 14 percent Tama soils, and 16 percent soils of minor extent.

Muscatine soils are nearly level and gently sloping and are somewhat poorly drained. The surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 12 inches thick. The subsoil is about 26 inches thick. It is dark grayish brown, friable silty clay loam with grayish brown and yellowish brown mottles. The substratum is olive gray silt loam.

Garwin soils are nearly level and are poorly drained. The surface layer is black silty clay loam about 7 inches

thick. The subsurface layer is black and very dark gray silty clay loam about 15 inches thick. The subsoil is olive gray, friable silty clay loam about 26 inches thick. The substratum is light brownish gray silt loam.

Tama soils are nearly level to moderately sloping and are well drained. The surface layer is black silty clay loam and is about 8 inches thick, except where eroded. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is dark yellowish brown friable silty clay loam about 29 inches thick with some mottles in the lower part. The substratum is dark yellowish brown and yellowish brown silt loam from about 44 to 56 inches. Yellowish brown sandy loam and loam layers begin at about 56 inches.

Of minor extent are the poorly drained Colo soils in drainageways, the somewhat poorly drained Ely soils on alluvial fans or foot slopes, and the moderately well drained Dinsdale soils on ridgetops and side slopes.

Most of the association is cultivated. Areas of permanent pasture, which are fenced, are generally along small drainageways. Most trees are in groves or windbreaks near farm buildings.

These soils are well suited to all cultivated crops commonly grown in the county. The main enterprises are growing corn and soybeans for cash crops and feeding hogs and beef cattle. The principal management concerns are improving drainage and controlling erosion. Tile drains are needed for maximum yields on the Garwin soils, on the nearly level areas of Muscatine soils, and along drainageways. On the gently sloping Tama soils, contouring is generally adequate to control erosion. On the moderately sloping soils, a combination of terracing and contouring is generally needed.

3. Kenyon-Clyde-Floyd association

Nearly level to strongly sloping, moderately well drained to poorly drained loamy and silty soils; on uplands

The characteristic landscape of this association is long, gentle slopes, slightly rounded hills, and many drainageways and small streams. In some areas the hill-

sides are moderately sloping and strongly sloping, and the slopes are shorter.

The soils of this association formed in loamy overburden and the underlying glacial till (fig. 3). In the Clyde and Floyd soils, a stratified valley fill material is between the overburden and the glacial till. Water moves more rapidly in the loamy overburden and stratified valley fill material than in the till, accumulates at the contact surface between these materials, and moves downslope along the line of contact. It may emerge part way down the slope as a seepy spot, or it may wet a large part of the slope.

This association occupies about 7 percent of the county. It is about 28 percent Kenyon soils, 24 percent Clyde soils, 18 percent Floyd soils, and 30 percent soils of minor extent (fig. 4).

Kenyon soils are gently sloping to strongly sloping and are moderately well drained. The surface layer is very dark brown loam that is about 11 inches thick, except where eroded. The subsurface layer is dark brown, very dark brown, and very dark grayish brown loam about 7 inches thick. The subsoil is loam about 36 inches thick. It

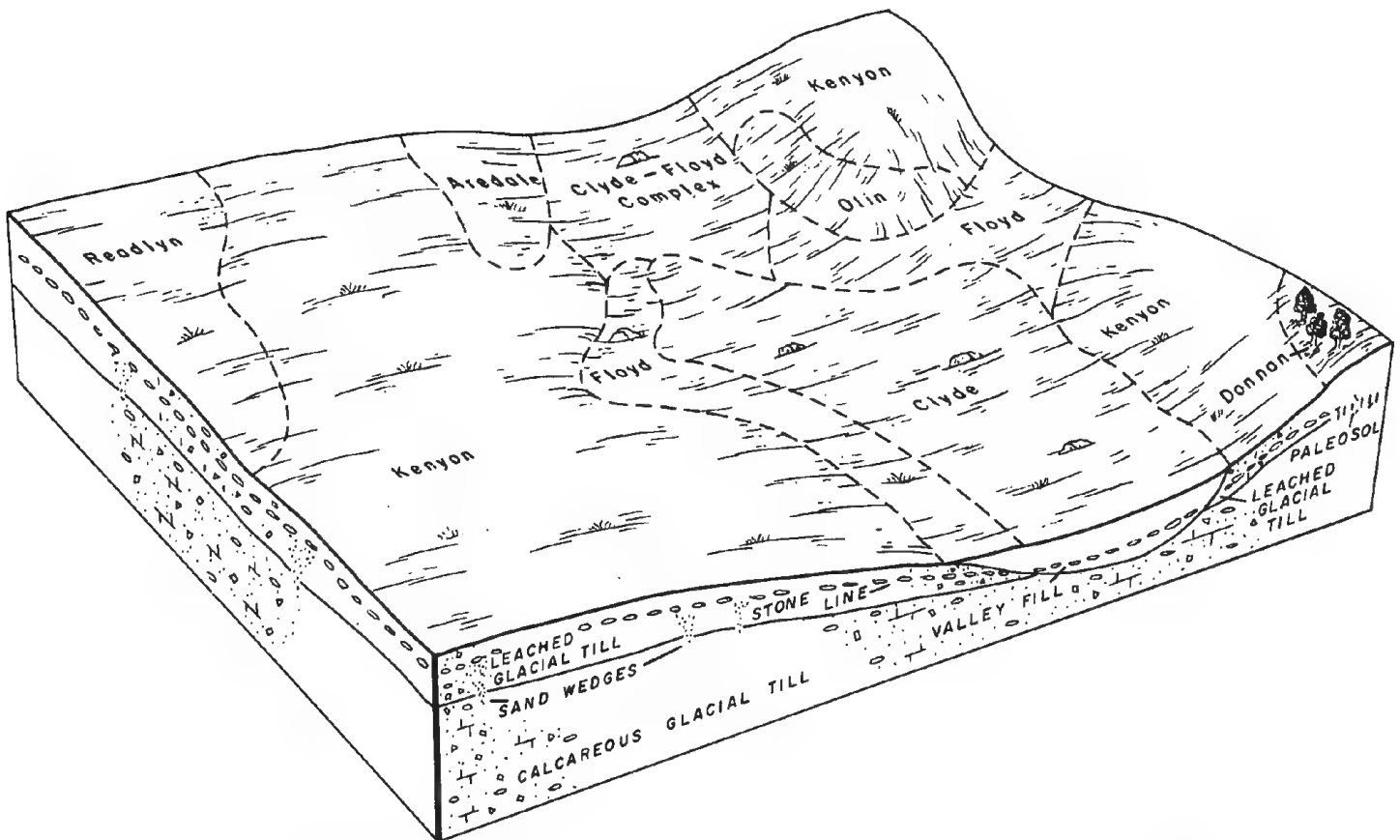


Figure 3.—Relationship of slope and parent material to the soils of the Kenyon-Clyde-Floyd association.



Figure 4.—Typical landscape in the Kenyon-Clyde-Floyd association. Floyd soils are in the foreground. Kenyon and Tripoli soils are in the background. Clyde soils are around the area of very light colored Dickinson soil.

is brown in the upper part, dark yellowish brown and yellowish brown in the middle part, and mottled yellowish brown and grayish brown in the lower part. The substratum is mottled grayish brown and yellowish brown calcareous loam.

Clyde soils are nearly level and are poorly drained. The surface layer is black silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown, olive gray, and dark gray, friable silty clay loam and loam in the upper part, olive gray, very friable sandy loam and loamy sand in the middle part, and mottled gray and yellowish brown, firm loam in the lower part. The substratum is mottled gray and yellowish brown loam. Clyde soils are adjacent to drainageways and intermittent streams and on the lower slopes of some ridges. Some Clyde soils, which are undrained, are permanent pasture or are sloughs. Stones and boulders that interfere with cultivation and tile installation are in many of these unimproved pastures.

Floyd soils are gently sloping and are somewhat poorly drained. The surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark

grayish brown loam about 15 inches thick. The subsoil is about 38 inches thick. It is dark grayish brown and grayish brown, friable loam and sandy clay loam in the upper part, grayish brown, friable sandy loam in the middle part, and mottled yellowish brown and grayish brown, firm loam in the lower part. The substratum is mottled yellowish brown and grayish brown loam.

Of minor extent are the well drained Aredale soils and somewhat poorly drained and moderately well drained Donnan soils on ridgetops and side slopes; the well drained and somewhat excessively drained Dickinson soils, well drained and somewhat excessively drained Olin soils, and excessively drained Sparta soils on convex ridgetops and side slopes; the somewhat poorly drained Readlyn soils on ridgetops; and the poorly drained Tripoli soils on broad, flat ridgetops.

A large part of this association is cultivated. Unimproved drainageways, where boulders and large rocks interfere with cultivation, are generally used for permanent pasture. Most trees are in groves or windbreaks near farm buildings.

These soils are suited to all cultivated crops commonly grown in the county. The main enterprises are growing

corn and soybeans for cash crop and feeding hogs and beef cattle. The principal management concerns are improving drainage, controlling erosion, and improving fertility. Because wetness in Clyde and Floyd soils is caused partly by hillside seepage, interceptor tile are needed upslope from wet areas. Terracing is generally needed with the tile to control the risk of erosion.

4. Colo-Ely-Waukegan association

Nearly level to moderately sloping, well drained to poorly drained silty soils; on bottom lands, stream benches, and foot slopes

This association is dominantly nearly level and gently sloping but is moderately sloping in some areas and is strongly sloping in a few areas along the bench escarpments. The soils on bottom lands and the soils on benches form two distinct associations, but mapping them separately is impractical because of their close association in the generally narrow stream valleys. Many soils on bottom lands are subject to frequent flooding; those on benches are commonly free of flooding.

This association makes up about 13 percent of the county. It is about 30 percent Colo soils, 10 percent Ely soils, 6 percent Waukegan soils, and 54 percent soils of minor extent.

Colo soils are on bottom lands and in narrow drainageways in uplands. They are poorly drained. Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 31 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is olive gray, friable silty clay loam about 13 inches thick. The substratum is also olive gray silty clay loam.

Ely soils are on foot slopes and alluvial fans. They are somewhat poorly drained. Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is black, very dark gray, and very dark grayish brown silty clay loam about 26 inches thick. The subsoil is dark grayish brown, friable silty clay loam about 24 inches thick. The substratum is yellowish brown sandy loam and dark yellowish brown loam.

Waukegan soils are on stream benches along rivers and major streams. They are well drained. Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silt loam about 5 inches thick. The subsoil is about 36 inches thick. It is brown and dark yellowish brown, friable silty clay loam in the upper part, dark yellowish brown, friable silt loam and loam in the middle part, and yellowish brown, loose loamy sand in the lower part. The substratum is yellowish brown sand.

The soils of minor extent are the poorly drained Bremer soils and somewhat poorly drained Nevin soils on low stream benches, the well drained Tama soils on high stream benches, and the poorly drained and very poorly drained Walford soils and well drained Wauke soils on stream benches.

Most of this association is cultivated. Some areas along the major streams are permanent pasture or woodland. Trees are along fence lines and in groves around farmsteads.

The soils of this association are well suited to all cultivated crops commonly grown in the county. A farm seldom lies wholly within the association. The main enterprises are growing corn and soybeans for cash crops and feeding hogs and beef cattle. The major concerns of management are controlling flooding, improving drainage, and maintaining tilth and fertility.

5. Fayette-Downs association

Gently sloping to very steep, well drained silty soils; on uplands

The characteristic landscape of this association is gently sloping and moderately sloping ridgetops, moderately sloping to very steep side slopes, and narrow valleys. The association is more rolling and hilly than most of the county. It includes a series of gently sloping to very steep, dome-shaped hills called "pahas," which tend to be oriented northwest to southeast. These hills are rather prominent because the surrounding topography is nearly level to gently sloping.

The soils in this association formed in deep loess (fig. 5). Because erosion is greater in areas of more sloping soils and because the native vegetation was trees rather than grass, the surface layer of the Fayette and Downs soils is relatively thinner and lighter colored than that of many soils in the county.

This association makes up about 11 percent of the county. It is about 75 percent Fayette soils, 15 percent Downs soils, and 10 percent soils of minor extent.

Fayette soils are gently sloping to very steep. They are well drained. Typically, the surface layer is very dark grayish brown silt loam that is about 5 inches thick unless eroded. The subsurface layer is brown and dark grayish brown silt loam about 5 inches thick. The subsoil is about 36 inches thick. It is brown, friable silt loam in the upper few inches, brown and dark yellowish brown, friable silty clay loam in the middle part, and yellowish brown, friable silty clay loam in the lower part. The substratum is yellowish brown silt loam.

Downs soils are gently sloping to strongly sloping. They are well drained. Typically, the surface layer is very dark grayish brown silt loam that is about 7 inches thick unless eroded. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is 42 inches thick. It is brown and dark yellowish brown, friable silty clay loam in the upper and middle part and mottled brown and yellowish brown, friable silt loam in the lower part. The substratum is mottled brown and yellowish brown silt loam.

The soils of minor extent are the somewhat poorly drained Atterberry soils on flat ridgetops, the well drained Lindley soils on the lower part of side slopes, and the moderately well drained Nodaway and somewhat poorly drained Radford soils along the narrow drainageways.

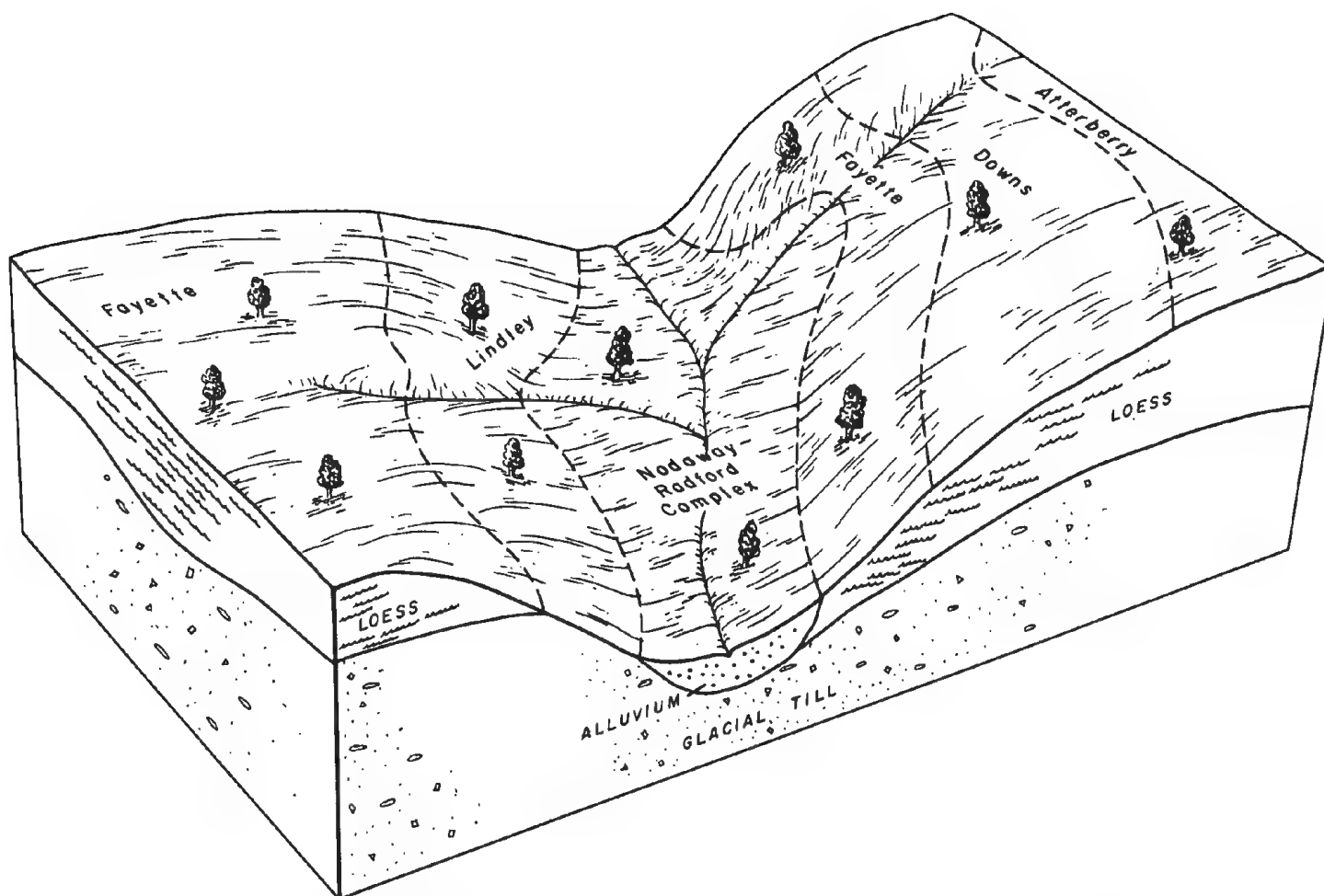


Figure 5.—Relationship of slope and parent material to the soils of the Fayette-Downs association.

This association is mostly used for permanent pasture where slopes are too steep to be cultivated. Soils on the nearly level to moderately sloping ridgetops are well suited to all cultivated crops commonly grown in the county. Patches of oak-hickory forest remain from the native vegetation; a few are large. Trees are also along roads, fence lines, and drainageways, in groves, and around farmsteads. The areas of woodland and the wide distribution of trees are distinctive features of the association.

Most farmsteads are on ridgetops, but a few are in small valleys. Fields are commonly small and irregular in shape. The main enterprises are raising beef cattle and hogs and some dairying. The principal concern of management is controlling erosion in cultivated areas. Gully erosion is a greater problem in this association than in the other associations. General improvement of fertility is also needed.

6. Dickinson-Sparta-Chelsea association

Nearly level to very steep, well drained or somewhat excessively drained and excessively drained sandy and loamy soils; on uplands

The characteristic landscape of this association is gently sloping ridgetops to very steep side slopes dissected by many waterways. Limestone crops out at the surface in many places, especially along major streams.

The soils of this association formed in wind deposited or wind reworked alluvial sand, loamy sand, or sandy loam.

This association occupies about 5 percent of the county. It is about 25 percent Dickinson soils, 20 percent Sparta soils, 15 percent Chelsea soils, and 40 percent soils of minor extent.

Dickinson soils are nearly level to moderately sloping. They are well drained or somewhat excessively drained. The surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is 15 inches thick. It is dark yellowish brown and brown, very friable fine sandy loam in the upper part and dark yellowish brown, very friable loamy sand in the lower few inches. The substratum is yellowish brown and brown loamy sand and sand.

Sparta soils are nearly level to strongly sloping and are excessively drained. The surface layer is very dark brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 12 inches thick. The subsoil is brown, very friable loamy fine sand about 8 inches thick. The substratum is yellowish brown sand.

Chelsea soils are gently sloping to very steep and are excessively drained. The surface layer is dark brown loamy fine sand about 4 inches thick. The subsurface layer is brown, yellowish brown, and dark yellowish brown loamy fine sand and fine sand about 37 inches thick. The next layer is similar to the subsurface layer but has thin bands of brown loamy fine sand beginning at a depth of about 42 inches.

Of minor extent are the well drained Aredale soils and somewhat excessively drained Sogn soils on side slopes, the somewhat excessively drained Backbone soils on convex, rounded ridgetops and side slopes, the poorly drained Clyde soils and somewhat poorly drained Floyd soils in upland swales and drainageways, the well drained Lamont soils on convex rounded ridges and side slopes, and the well drained Whalan soils on ridgetops and side slopes.

The soils of this association are mostly used for hay and pasture and for row crops in rotation with oats and hay. Some areas are permanent pasture. Small to large areas of oak-hickory woodland remain from the native vegetation. Other trees are along roads, fence lines, and drainageways, in groves, and around farmsteads.

Fields in this association are commonly small. Many of the soils are not well suited to cultivated crops. The soils on the steeper slopes are not suited to cultivated crops because of the erosion hazard and the difficulty of cultivation. They tend to be droughty and subject to erosion.

7. Fluvaquents-Spillville-Flagler association

Level to gently sloping, excessively drained to very poorly drained loamy and sandy soils; on bottom lands and stream benches

This association is dominantly level. Some areas, however, are gently sloping, and a few bench escarpments are strongly sloping to steep. The soils on bottom lands and the soils on benches form two distinct patterns, but mapping them separately is impractical because of their close association in the generally narrow stream valleys (fig. 6). Many of the soils on bottom lands are subject to

frequent flooding, but those on benches are generally free of flooding.

The soils of this association formed in dominantly loamy and sandy alluvial material.

This association occupies about 4 percent of the county. It is about 33 percent Fluvaquents, 14 percent Spillville soils, 10 percent Flagler soils, and 43 percent soils of minor extent.

Fluvaquents are nearly level, stratified sandy and loamy soils that are frequently flooded. They are very poorly drained to excessively drained. They are channeled and contain low natural levees, small ponds, sloughs, and small oxbows. Water often remains ponded in the oxbows.

Spillville soils are nearly level. They are moderately well drained and somewhat poorly drained and are subject to flooding. The surface layer is very dark brown loam about 21 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 31 inches thick. The substratum is dark brown fine sand.

Flagler soils are nearly level to gently sloping and are somewhat excessively drained. The surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown sandy loam about 15 inches thick. The subsoil is about 13 inches thick. It is dark yellowish brown; very friable sandy loam in the upper part and brown, loose gravelly sand in the lower part. The substratum is brown sand.

Of minor extent are the excessively drained Chelsea soils on high stream benches, the excessively drained Finchford soils on high flood plains, the moderately well drained Hanlon soils on low benches and alluvial fans, and the somewhat poorly drained Lawler soils and well drained Saude and Waukee soils on stream benches.

Much of this association is used for pasture and woodland because it is frequently flooded. The soils on benches, which are seldom flooded, are cultivated.

Farm enterprises are determined by surrounding associations because an entire farm seldom lies wholly within this association. The concerns of management are controlling flooding, improving drainage, and maintaining tilth and fertility.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes

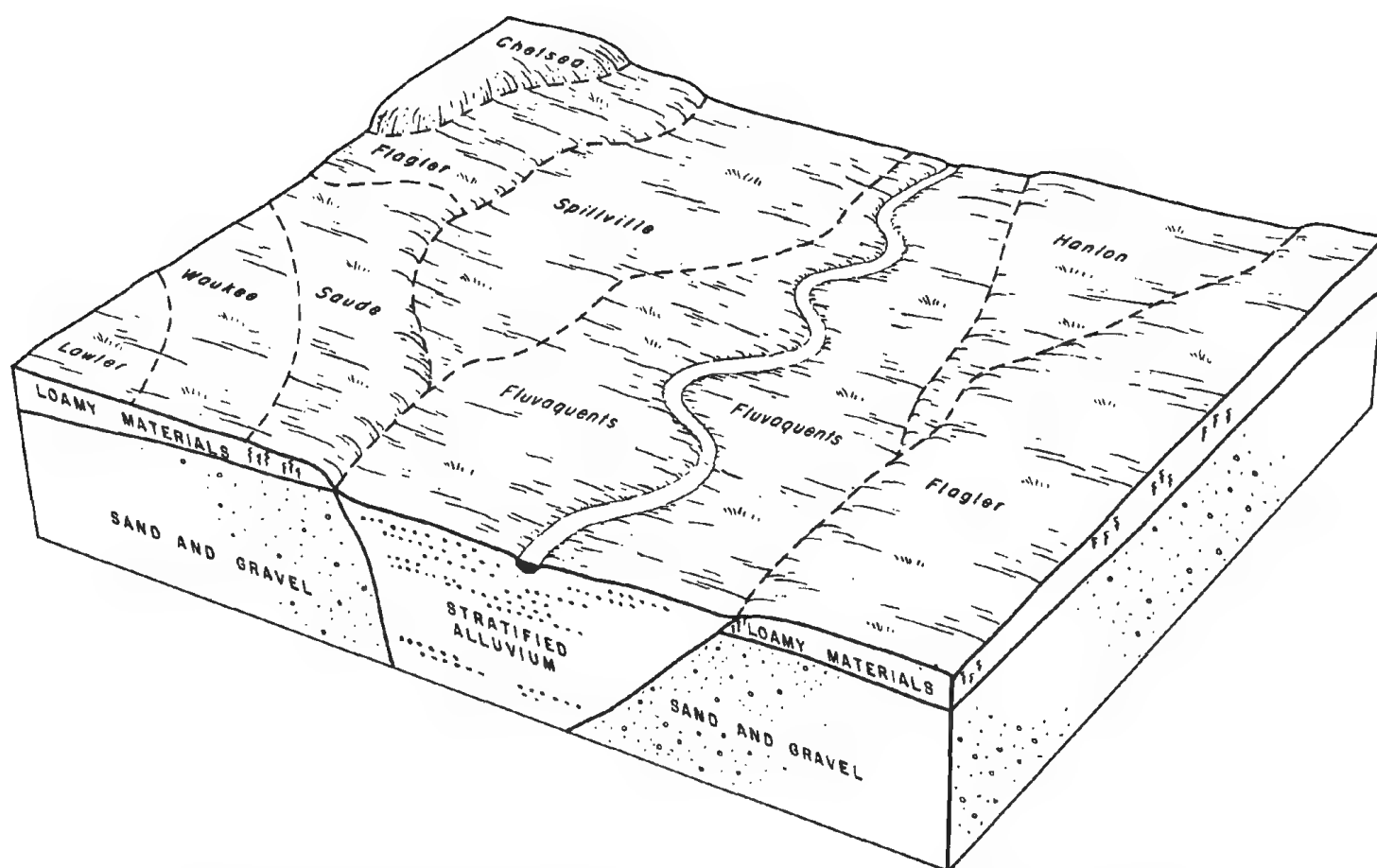


Figure 6.—Relationship of slope and parent material to the soils of the Fluvuquents-Spillville-Flagler association.

general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Dinsdale silty clay loam, 2 to 5 percent slopes, is one of several phases in the Dinsdale series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they

cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Colo-Ely complex, 2 to 5 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables")

give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

11B—Colo-Ely complex, 2 to 5 percent slopes. This map unit consists of gently sloping, somewhat poorly drained and poorly drained soils in narrow upland drainageways along small streams and waterways. Individual areas range from 20 acres to 200 acres or more.

This unit is about 60 percent Colo soil and 40 percent Ely soil. The Colo soil is along the stream or waterway, and the Ely soil is along the outer edge of the map unit. The Colo soil is subject to flooding, but the Ely soil is not. Areas of these soils are so intricately mixed that it is not practical to map them separately.

Typically, the surface layer of the Colo soil is black silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 31 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is olive gray, friable silty clay loam about 13 inches thick. The substratum is olive gray silty clay loam.

Typically, the surface layer of the Ely soil is black silt loam about 8 inches thick. The subsurface layer is silty clay loam about 26 inches thick. The upper part is black, the middle part very dark gray, and the lower part very dark grayish brown. The subsoil is dark grayish brown, friable silty clay loam about 24 inches thick. The substratum is yellowish brown sandy loam and dark yellowish brown loam.

Included with these soils in mapping are areas where 6 to 10 inches of lighter colored overwash lower in organic matter has been deposited. These areas are on gently sloping fans at the mouth of small drainageways. They make up less than 5 percent of the map unit.

Permeability is moderate in Colo and Ely soils. Surface runoff is medium, but overwash is received from adjacent soils. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 7.0 percent. Reaction in the surface layer is neutral or slightly acid. Tilth is fair to good.

Most areas are cropland. Some are pasture or hayland. Most of this unit is cropped with the surrounding soils because individual areas are generally too narrow to be cropped separately. The unit is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This unit is moderately suited to corn, soybeans, and small grain. Because seepage from the uplands keeps this unit wet, tile drains are generally needed. The unit is subject to overwash and siltation from upslope. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This unit is moderately suited to grasses and legumes for hay and pasture. Overwash and siltation from adjacent soils may damage hay and pasture. Artificial drain-

age is needed to maintain a good stand. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

41—Sparta loamy fine sand, 0 to 2 percent slopes.

This nearly level, excessively drained soil is on benches or in uplands. Individual areas are irregular in shape and range from 20 to 200 acres.

Typically, the surface layer is very dark brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 14 inches thick. The subsoil is brown, very friable loamy fine sand about 12 inches thick. The substratum is yellowish brown, loose fine sand which, in most areas, is underlain by coarser sand and gravel below 4 feet. In some areas the combined thickness of the surface layer and subsurface layer is more than 24 inches. In some areas the surface layer is fine sand or fine sandy loam.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Runoff is slow. The available water capacity is low. The organic matter content of the plow layer is 1.0 to 1.5 percent. Reaction in the subsoil is generally medium acid or strongly acid. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good.

Most areas are cultivated. Some are pasture or hayland. This soil is poorly suited to cultivated crops and is moderately suited to hay, pasture, and trees. It is suited to many engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Wind erosion is a hazard in cultivated areas. Yields for all crops are below average, even under good management, unless rainfall is above average and timely. Conservation tillage and winter cover crops reduce wind erosion. Returning crop residue or adding other organic material helps to maintain fertility and reduce wind erosion.

This soil is moderately suited to grasses and legumes for hay and pasture. If it is used for hayland or pasture, however, there is little hazard of wind erosion. The carrying capacity of pasture is limited during the hot dry part of summer because of droughtiness.

The capability subclass is IVs.

41B—Sparta loamy fine sand, 2 to 5 percent slopes. This gently sloping, excessively drained soil is in uplands, in some dune-like areas, and on benches along the Cedar River. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is very dark brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 12 inches thick. The subsoil is brown, very friable loamy fine sand about 8 inches thick. The substratum is yellowish brown

fine sand. On benches, this soil generally is underlain by coarse sand and gravel. In a few areas the surface texture is fine sand or fine sandy loam.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is slow. The available water capacity is low. The organic matter content in the plow layer is 1.0 to 1.5 percent. Reaction is generally medium acid or strongly acid in the surface layer and the upper part of the subsoil unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good.

Many areas are cultivated. Some are pastureland or hayland. This soil is poorly suited to cultivated crops and is moderately suited to hay, pasture, and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to wind and water erosion if cultivated. Yields of all crops are below average, even under good management, unless rainfall is above average and timely. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce soil loss by wind and water. Terraces are difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion if it is used for hayland or pasture. Contouring also helps to reduce erosion. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IVs.

41C—Sparta loamy fine sand, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is in uplands and on stream benches. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsoil is dark yellowish brown, very friable loamy fine sand about 10 inches thick. The substratum is yellowish brown fine sand. In a few areas the surface layer is fine sand or fine sandy loam.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is medium. The available water capacity is low. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction is generally medium acid or strongly acid in the surface and the upper part of the subsoil, unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good.

Many areas are pastureland. Some are cultivated. This soil is poorly suited to crops and moderately suited to hay and pasture and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to wind and water erosion if cultivated.

Yields for all crops are below average, even under good management, unless rainfall is above average and timely. Conservation tillage, winter cover crops, and grassed waterways reduce erosion by wind and water. Terraces are difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and to reduce erosion.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion if it is used for hayland or pasture. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IVs.

41D—Sparta loamy fine sand, 9 to 14 percent slopes. This strongly sloping, excessively drained soil is on convex side slopes along major streams or drainageways and in some places on narrow convex ridges. Individual areas are irregular in shape and range from 5 to 20 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 5 inches thick. The subsoil is dark yellowish brown, very friable loamy fine sand about 10 inches thick. The substratum is yellowish brown fine sand. In a few areas the surface layer is fine sand or fine sandy loam.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is moderately rapid. The available water capacity is low. The organic matter content in the plow layer is less than 0.5 percent. Reaction is generally medium acid or strongly acid in the surface layer and the upper part of the subsoil. The subsoil is generally very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are in pasture. This soil is poorly suited to cultivated crops and to hay, pasture, and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to wind and water erosion if cultivated. Yields are very low.

This soil is poorly suited to grasses and legumes for hay and pasture. There is little hazard of erosion if it is used for pasture or hay. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is VI_s.

51—Vesser silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is in level or slightly depressed areas on flood plains or low stream benches. It is subject to occasional flooding. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark

gray silt loam about 12 inches thick. The subsoil is about 41 inches thick. The upper part is black, firm silty clay loam; the middle part is dark gray and gray, firm silty clay loam; and the lower part is light gray, friable silty clay loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction in the surface layer is generally medium acid unless the soil has been limed in the last 5 years. The subsoil is medium in available phosphorus and low in available potassium. Tilth is generally good.

Nearly all areas are cropland. This soil is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is somewhat poorly drained or poorly drained and is subject to ponding. Surface drainage and tile drainage are needed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on alluvial flood plains along rivers and major streams. It is subject to occasional flooding. Individual areas are irregular in shape and range from 10 to 200 acres or more.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is about 37 inches thick. The upper part is black, silty clay loam, and the lower part is black, silty clay. The substratum is black and very dark gray silty clay and clay loam.

Permeability is slow. Surface runoff is very slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction is generally neutral or slightly acid in the surface layer. The subsurface layer is low in available phosphorus and very low in available potassium. Tilth is generally fair to poor.

Many areas are cropland. Some are pastureland. This soil is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is poorly drained and is subject to occasional flooding. Because tile drains function slowly, surface drains are necessary. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is moderately suited to grasses for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper

stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIw.

63B—Chelsea loamy fine sand, 1 to 5 percent slopes. This gently sloping, excessively drained soil is in uplands. A few areas are on benches along the Cedar River. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is dark brown loamy fine sand about 4 inches thick. The subsurface layer is yellowish brown fine sand about 37 inches thick. The next layer to a depth of 60 inches or more is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick. In some small areas, the surface layer is fine sandy loam.

Permeability is rapid. Surface runoff is slow. The available water capacity is low. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction is generally medium acid or strongly acid in the surface layer. Lower layers are generally very low in available phosphorus and available potassium.

Most areas are pastureland or woodland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to wind and water erosion if cultivated. Yields for all crops are below average, even under good management, unless rainfall is above average and timely. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce erosion by wind and water. Terraces are difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This soil is moderately suited to hay and pasture. There is little hazard of erosion on hayland or pasture. The carrying capacity for pasture is limited during mid-summer because of droughtiness.

The capability subclass is IVs.

63C—Chelsea loamy fine sand, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is in uplands on mound-like ridges and side slopes. A few areas are on high stream benches. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is dark brown loamy fine sand about 4 inches thick. The subsurface layer is brown, yellowish brown, and dark yellowish brown fine sand about 37 inches thick. The next layer to a depth of 60 inches or more is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick. In some small areas the surface layer is fine sandy loam.

Permeability is rapid. Surface runoff is medium. The available water capacity is low. The organic matter con-

tent in the plow layer is less than 0.5 percent. Reaction is generally medium acid or strongly acid in the surface layer. Lower layers are generally very low in available phosphorus and available potassium.

Most areas are pastureland or woodland. This soil is poorly suited to cultivated crops. It is moderately suited to hay and pasture and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to wind and water erosion if cultivated. Yields for all crops are below average, even under good management, unless rainfall is above average and timely. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce erosion by wind and water. Terraces are difficult to construct and maintain because of low stability. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This soil is moderately suited to hay and pasture. There is little hazard of erosion on hayland or pasture. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IVs.

63D—Chelsea loamy fine sand, 9 to 18 percent slopes. This strongly sloping and moderately steep, excessively drained soil is on upland ridges and side slopes. Individual areas are irregular in shape and generally range from 5 to 50 acres.

Typically, the surface layer is brown loamy fine sand about 2 inches thick. The subsurface layer is yellowish brown fine sand about 30 inches thick. The next layer to a depth of 60 inches or more is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick.

Permeability is rapid. Surface runoff is moderately rapid. The available water capacity is low. The organic matter content in the plow layer is less than 0.5 percent. Reaction is generally medium acid or strongly acid in the surface layer. Lower layers are generally very low in available phosphorus and available potassium.

Most areas are pastureland or woodland. This soil is poorly suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to severe wind and water erosion if cultivated. Yields are very low.

This soil is poorly suited to hay and pasture. If it is used for pasture or hayland, however, there is little hazard of erosion. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is VI_s.

63F—Chelsea loamy fine sand, 18 to 25 percent slopes. This steep, excessively drained soil is on irregular, convex side slopes in uplands. Individual areas are irregular in shape and generally range from 5 to 40 acres.

Typically, the surface layer is brown loamy fine sand about 2 inches thick. The subsurface layer is yellowish brown fine sand about 26 inches thick. The next layer to a depth of 60 inches or more is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick.

Permeability is rapid. Surface runoff is rapid. The available water capacity is low. The organic matter content in the plow layer is less than 0.5 percent. Reaction is generally medium acid or very strongly acid. Lower layers generally are very low in available phosphorus and available potassium.

Most areas are woodland. This soil is poorly suited to cultivated crops and hay. It is suited to pasture and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. It is subject to very severe wind and water erosion if cultivated. Yields are very low.

This soil is poorly suited to hay but is suited to pasture. If it is used for pasture, there is little hazard of erosion. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is VII_s.

65E2—Lindley loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on convex side slopes and nose slopes in uplands. Individual areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is dark brown loam with some mixing of yellowish brown clay loam and is about 6 inches thick. The subsoil is yellowish brown, firm clay loam about 44 inches thick. The substratum is yellowish brown clay loam.

Included with this soil in mapping are soils that formed in 14 to 24 inches of friable loam over firm clay loam. Also included are areas where the subsoil is reddish brown silty clay. These areas are in a narrow band around the heads of some drainageways. They are wetter than this Lindley soil. They make up less than 4 percent of the map unit.

Permeability is moderately slow, and surface runoff is rapid. The available water capacity is high. The organic matter content of the plow layer is less than 0.5 percent. Reaction is generally strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is medium in available phosphorus and very low in available potassium. Tilth generally is poor. The soil becomes cloddy if worked when too wet.

Most areas are permanent pasture. A few are woodland. Many areas were cropped in the past. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. There is a severe hazard of erosion in cultivated areas. Conservation tillage, winter cover crops, and contouring reduce soil loss. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is moderately suited to grasses and legumes. There is little hazard of erosion on pastureland. Harvesting hay is somewhat difficult because of the steepness of the slopes. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and may cause gulying along livestock trails. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep pasture and soil in good condition.

This soil is moderately suited to trees. If it is used for woodland, there is little hazard of erosion. Proper management is needed to maintain good stands.

The capability subclass is VIe.

65F—Lindley loam, 18 to 25 percent slopes. This steep, well drained soil is on convex side slopes and nose slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is brown and dark brown loam about 5 inches thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is yellowish brown, firm clay loam about 42 inches thick. The substratum is yellowish brown clay loam.

Included with this soil in mapping are small areas where the subsoil is reddish brown silty clay. These areas are in a narrow band around the heads of some drainageways. They are wetter than this Lindley loam. They make up less than 3 percent of the map unit.

Permeability is moderately slow. Surface runoff is rapid. The available water capacity is high. The organic matter content in the plow layer is less than 0.5 percent. Reaction is generally strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is medium in available phosphorus and very low in available potassium. Tilth is generally fair, but the soil becomes cloddy if worked when too wet.

Most areas are permanent pasture. Some are woodland. This soil is poorly suited to cultivated crops and moderately suited to pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. The hazard of erosion is very severe in cultivated areas. The steep slope makes use of machinery hazardous.

This soil is moderately suited to grasses and legumes and pasture. There is little hazard of erosion if it is used for pasture. Harvesting hay is somewhat difficult because of the steepness of the slopes. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and may cause gulying along livestock trails. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

This soil is moderately suited to trees. There is little hazard of erosion in woodland. Proper management is needed to maintain good stands.

The capability subclass is VIIe.

65F3—Lindley clay loam, 18 to 25 percent slopes, severely eroded. This steep, well drained soil is on

convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is mixed brown and yellowish brown clay loam about 2 inches thick. The subsoil is yellowish brown, firm clay loam about 38 inches thick. The substratum is yellowish brown clay loam.

Included with this soil in mapping are small areas where the subsoil is reddish brown silty clay. These areas are in a narrow band around the heads of some drainageways and are wetter than this Lindley soil. They make up less than 3 percent of the map unit.

Permeability is moderately slow. Surface runoff is rapid. The available water capacity is high. The organic matter content of the plow layer is less than 0.5 percent. Reaction is usually strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is medium in available phosphorus and very low in available potassium. Tilth is poor. The surface layer is generally cloddy.

Most areas are permanent pasture. This soil is poorly suited to cultivated crops and hay. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. The hazard of erosion is very severe in cultivated areas. Yields may be very low. The steep slope makes use of machinery hazardous.

This soil is poorly suited to grasses and legumes. Pastureland, however, is one of the best uses for this soil. There is little hazard of erosion on well managed areas. Reseeding may be difficult because of the clay loam texture, firm consistence, and low fertility in the surface layer. Fertilizer, lime, and a seeding method that leaves intact as much of the old vegetation as possible are needed. Harvesting hay is somewhat difficult because of the steepness of the slope. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and may cause gulying along livestock trails. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

This soil is moderately suited to trees. Production is low on timberland, but the hazard of erosion is also low. Seedling mortality is high unless suitable species are selected. Proper management is needed to maintain good stands.

The capability subclass is VIIe.

83B—Kenyon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape. They range from 5 to several hundred acres and may extend across several farms.

Typically, the surface layer is very dark brown loam about 11 inches thick. The subsurface layer is very dark grayish brown, brown, and dark brown loam about 7 inches thick. The subsoil is about 36 inches thick. The upper part is brown, friable loam; the middle part is yellowish brown and dark yellowish brown, firm loam;

and the lower part is mottled grayish brown and yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of the difference in permeability, water tends to move laterally. In wet seasons seepy areas may develop for short periods. Runoff is medium. The available water capacity is high. The organic matter content of the plow layer is 3.0 to 4.0 percent. Reaction in the surface layer is generally medium acid or slightly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good.

Nearly all areas are cropland. Some are pasture or hayland. This soil is well suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, are needed. If this soil is contoured or terraced, tile drains are needed to prevent seepy spots. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pasture. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

83C—Kenyon loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape. They range from 10 to several hundred acres and may extend across several farms.

Typically, the surface layer is very dark brown loam about 11 inches thick. The subsurface layer is very dark brown loam about 4 inches thick. The subsoil is about 39 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown, firm loam; and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas, the surface layer is sandy loam.

Included with this soil in mapping are areas where the surface layer is thinner and lower in organic matter. These areas are on the steepest part of the side slopes and on the convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of the difference in permeability, water tends to move later-

ally. In wet seasons seepy areas may develop for short periods. Surface runoff is medium. The available water capacity is high. The organic matter content of the plow layer is 3.0 to 4.0 percent. Reaction in the surface layer is generally medium acid or slightly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good.

Many areas are cropland. Many are hayland or pasture. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, tile drains are needed to prevent seepy spots. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pasture. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

83C2—Kenyon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 200 acres or more.

Typically, the surface layer is very dark grayish brown loam with some mixing of brown loam and is about 8 inches thick. The subsoil is about 38 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown, firm loam; and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Included in mapping are areas where most of the topsoil has been removed by erosion. In these areas the organic matter content is lower than in this Kenyon soil. These areas are on the steepest part of side slopes and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of the difference in permeability, water tends to move laterally, and in wet seasons seepy areas may develop for short periods. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 2.0 to 3.0 percent. Reaction in the surface layer is generally medium acid or slightly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potas-

sium. Tilth is commonly poor, and the soil is commonly cloddy.

Most areas are cropland or were cropped in the past. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available phosphorus, available potassium, and organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in less eroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some areas causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways are needed to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, tile drains are needed to prevent seepy spots. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing help to keep the pasture and soil in good condition.

The capability subclass is IIIe.

83D—Kenyon loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsurface layer is very dark grayish brown loam about 2 inches thick. The subsoil is about 37 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown, firm loam; and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are areas where the surface layer is thinner and lower in organic matter. These areas are on the steepest part of side slopes and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part and substratum. Because of the difference in permeability, water tends to move laterally and seepy areas may develop for short periods in wet seasons. Runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is 2.0 to 3.0 percent. Reaction in the surface layer is generally medium acid or slightly

acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good.

Many areas are cropland. Many are hayland or pastureland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, tile drains are needed to prevent seepy spots. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

83D2—Kenyon loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam with some mixing of brown loam and is about 8 inches thick. The subsoil is about 33 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown, firm loam; and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are small areas where most of the original surface layer has been removed by erosion. In these areas the organic matter content is lower than in this Kenyon soil. These areas are on the steepest part of side slopes and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of the difference in permeability, water tends to move laterally, and in wet seasons seepy areas may develop for short periods. Runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is 1.0 to 2.0 percent. Reaction in the surface layer is generally medium acid or slightly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and very low in available potassium. Tilth is generally poor. The soil is cloddy if worked when too wet.

Most areas are cropland. Some are pastureland or hayland. This soil is moderately suited to cultivated crops

and to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Some material from the subsoil, which is very low in phosphorus, potassium, and organic matter, has been mixed into the plow layer. As a result, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, tile drains are needed to prevent seepy spots. Returning crop residue or adding other organic matter helps to improve fertility and tilth.

This soil is moderately suited to legumes and grasses for hay and pasture. If it is used for hay or pasture, there is little hazard of erosion. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

84—Clyde silty clay loam, 0 to 2 percent slopes.

This nearly level, poorly drained soil is along drainageways and in lower concave areas in uplands. It is subject to frequent flooding. Individual areas are irregular or long and range from 20 to 200 acres or more.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown, olive gray, and dark gray, friable silty clay loam and loam; the middle part is olive gray, very friable sandy loam and loamy sand; and the lower part is mottled gray and yellowish brown, firm loam. The substratum is gray and yellowish brown loam.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 9.0 to 11.0 percent. Reaction is generally neutral or slightly acid in the surface layer. The subsoil is very low in available phosphorus and available potassium. Tilth is generally fair unless the soil has been worked when too wet.

Many areas are cropland. Many are pastureland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains, however, are needed to utilize the full potential of the soil. Because wetness is partly the result

of hillside seepage, a drainage system that intercepts laterally moving water is most successful. Stones and boulders are common in many unimproved areas and must be removed before the soil can be cropped. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to hay or pasture if it is adequately drained. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing help to keep the pasture and soil in good condition.

The capability subclass is IIw.

109C—Backbone fine sandy loam, 4 to 12 percent slopes. This moderately sloping and strongly sloping, somewhat excessively drained soil is on ridges and convex side slopes in uplands. Individual areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is dark brown with some brown fine sandy loam about 9 inches thick. The subsurface layer is dark yellowish brown fine sandy loam about 2 inches thick. The subsoil is about 23 inches thick. It is dominantly dark yellowish brown, friable fine sandy loam. Fractured limestone bedrock is at 34 inches. In some areas the surface layer is lighter colored and thinner.

Permeability is moderately rapid in the upper part of the soil and moderately slow in the lower part. Surface runoff is medium. The available water capacity is very low to low. Organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction in the surface and subsurface layers is generally neutral or slightly acid but is strongly acid in some areas. The subsoil is generally low in available phosphorus and very low in available potassium. Tilth is fair.

Many areas are cropland or pastureland. Some are woodland. This soil is poorly suited to cultivated crops, hay and pasture, and trees. It is moderately or poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Yields are below average unless rainfall is above average and timely. Both wind and water erosion are hazards in cultivated areas. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce erosion. Terraces are difficult to construct because of shallowness over limestone. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This soil is poorly suited to grasses and legumes for hay and pasture. There is little hazard of erosion, however, on hayland or pasture. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IVs.

110B—Lamont fine sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on upland ridges or high stream benches. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is very dark gray fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 6 inches thick. The subsoil is about 30 inches thick. The upper part is dark yellowish brown and dark brown, friable and very friable sandy loam, and the lower part is yellowish brown, very friable loamy sand. The substratum is yellowish brown loamy sand.

Permeability is moderately rapid in the upper part of the soil and very rapid in the lower part. Surface runoff is slow. The available water capacity is low. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction in the surface and subsurface layers is medium acid or strongly acid. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is fair.

Most areas are pastureland or woodland. A few are cropland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Yields tend to be below average unless rainfall is above average and timely. If this soil is cultivated, there is a hazard of both wind and water erosion. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce soil loss by wind and water. Terraces may be difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This soil is moderately suited to hay and pasture. If it is used for pasture or hay, however, there is little hazard of erosion. The carrying capacity for pasture is slightly limited during midsummer because of droughtiness.

The capability subclass is IIIe.

110C—Lamont fine sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on upland ridges and side slopes and on high stream benches. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark gray fine sandy loam about 3 inches thick. The subsurface layer is brown fine sandy loam about 5 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown and dark brown, friable and very friable sandy loam, and the lower part is yellowish brown, very friable sandy loam. The substratum is yellowish brown loamy sand.

Permeability is moderately rapid in the upper part of the soil and very rapid in the lower part. Surface runoff is medium. The available water capacity is low. The organic matter content in the plow layer is less than 0.5 percent. Reaction in the surface and subsurface layers is medium acid or strongly acid. The subsoil is generally medium in available phosphorus and very low in available potassium.

Most areas are pastureland or woodland. This soil is poorly suited to cultivated crops and moderately suited to hay, pasture, and trees and to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Yields are below average unless rainfall is above average and timely. Erosion by both wind and water is a hazard in cultivated areas. A less intensive cropping rotation or more conservation practices are needed on this soil than on the less sloping Lamont soils. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce soil loss by wind and water. Terraces may be difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This soil is moderately suited to hay and pasture. There is little hazard of erosion, however, on pasture or hayland. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IIIe.

118—Garwin silty clay loam, 0 to 2 percent slopes.

This nearly level, poorly drained soil is in uplands at the heads of concave drainageways. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 15 inches thick. The subsoil is about 26 inches thick. It is olive gray, friable silty clay loam. The substratum is light brownish gray silt loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.5 to 6.5 percent. Reaction is typically neutral or slightly acid in the surface layer. The subsoil is generally very low in available phosphorus and very low in available potassium. Tilth is fair unless the soil is worked when too wet.

Almost all areas are cropland. This soil is well suited to cultivated crops and hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Artificial drainage, however, is needed to use the soil to its full potential. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

119—Muscatine silty clay loam, 0 to 2 percent slopes.

This nearly level, somewhat poorly drained soil is on broad upland divides. Individual areas are irregular in shape. They range from 10 to several hundred acres and may extend across several farms.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper and middle part is dark grayish brown, and the lower part is dark grayish brown with grayish brown and yellowish brown mottles. The substratum is olive gray silt loam with yellowish brown mottles.

Included in mapping are small areas of Garwin soils, which are more poorly drained than Muscatine soils. Garwin soils are in small drainageways. They make up about 5 percent of the map unit.

Permeability is moderate. Surface runoff is slow. The available water capacity is very low. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction in the surface layer is generally medium acid or strongly acid unless the soil has been limed in the past 5 years. The subsoil is generally low in available phosphorus and very low in available potassium. Tilth is generally fair or good unless the soil has been worked when too wet.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of soil blowing in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth. Tile drains may be needed.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

119B—Muscatine silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on loess covered uplands around the heads of drainageways and on foot slopes. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 24 inches thick. The upper and middle part is dark grayish brown, and the lower part is dark grayish brown with yellowish brown mottles. The substratum is olive gray silt loam with yellowish brown mottles.

Permeability is moderate. Surface runoff is medium. The available water capacity is very high. The organic matter content in the plow layer is about 4.5 to 5.5 percent. Reaction in the surface layer is generally medium acid unless the soil has been limed in the past 5 years. The subsoil is generally low in available phosphorus and very low in available potassium. Tilth is generally

fair or good unless the soil has been worked when too wet.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of erosion in cultivated areas. The soil is subject to overwash from upslope and may be wet or seepy during periods of high rainfall. Terracing or contouring this soil and the area upslope reduces erosion. Tile drains may be needed to reduce wetness. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

120—Tama silty clay loam, 0 to 2 percent slopes. This nearly level, well drained soil is on narrow upland ridgetops. Individual areas are irregular in shape and range from 5 to 20 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark brown silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is dark brown and brown, and the lower part is dark yellowish brown. The substratum to a depth of 60 inches is dark yellowish brown silt loam. Below that, it is yellowish brown loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 3.5 to 4.5 percent. Reaction is typically medium acid or slightly acid in the surface layer and the upper part of the subsoil. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is good.

Nearly all areas are cropland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of soil blowing in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

120B—Tama silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on upland ridges

above the moderately sloping Tama soils. Individual areas are irregular in shape and range from 5 to 100 acres or more.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 29 inches thick. The upper few inches are brown, friable silty clay loam. The rest is dark yellowish brown, friable silty clay loam. Some mottles are in the lower part. The substratum to a depth of 56 inches is dark yellowish brown silt loam. Next is a layer of yellowish brown sandy loam 8 inches thick. Below that is yellowish brown loam. In some areas loam is at a depth as shallow as 36 inches.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction is typically medium acid or slightly acid in the surface layer and the upper part of the subsoil. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is good.

Nearly all areas are cropland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of erosion control practices, such as contouring and terracing, is difficult because of complex slopes. In most places, however, these practices are suitable. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

120C—Tama silty clay loam, 5 to 9 percent slopes.

This moderately sloping, well drained soil is on convex side slopes in uplands below the less sloping Tama soils. Individual areas are long and irregular in shape and range from 5 to 20 acres.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is dark brown silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The substratum to a depth of 48 inches is yellowish brown silt loam. Next is a layer of yellowish brown sandy loam. Below that is yellowish brown loam. In some areas loam is at a depth as shallow as 36 inches.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter

content in the plow layer is about 3.0 to 4.0 percent. Reaction is typically medium acid or slightly acid in the surface layer and the upper part of the subsoil. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is generally good.

Most areas are cropland. Some are permanent pasture or hayland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard on cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places, contouring and terracing are difficult because of irregular contours, but in most places these practices are suitable. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pasture. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poor tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

120C2—Tama silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex side slopes in uplands below the less sloping Tama soils. Individual areas are long and irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark brown silty clay loam with some mixing of brown silty clay loam and is about 8 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The substratum to a depth of 44 inches is yellowish brown silt loam. Next is a layer of dark yellowish brown sandy loam about 8 inches thick. Below that is yellowish brown loam. In some areas loam is at a depth as shallow as 36 inches.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 2.0 to 3.0 percent. Reaction is typically medium or slightly acid in the surface layer and the upper part of the subsoil. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth generally is poorer than in the uneroded Tama soils.

Most areas are cropland. A few are pastureland or hayland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Some material from the subsoil, which is very low in available phosphorus and has a much lower organic matter content than the surface layer, has been mixed into the plow layer. As a result, more fertilizer is needed

to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in the adjacent uneroded Tama soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places contouring and terracing are difficult because of irregular contours, but in most places these practices are suitable. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in even poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

122—Sperry silt loam, 0 to 1 percent slopes. This nearly level, poorly drained or very poorly drained soil is in level or slightly depressional areas on the broad, loess covered flat ridgetops in uplands. It is subject to frequent ponding. Individual areas are irregular in shape and range from 5 to 15 acres.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is very dark gray and dark gray silt loam about 13 inches thick. The subsoil is about 24 inches thick. The upper part is black, firm silty clay; the middle part is very dark gray, firm silty clay loam; and the lower part is dark gray, firm silty clay loam. The substratum is dark gray silty clay loam.

Permeability is slow and very slow. Surface runoff is very slow. The available water capacity is high. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction in the surface layer and the upper part of the subsoil is slightly acid or medium acid unless the soil has been limed within the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is fair unless the soil has been worked when too wet.

Almost all areas are cropland. This soil is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is poorly drained or very poorly drained and may be ponded at times. Both surface drainage and tile drainage are needed. Tile drains function slowly because of the slow and very slow permeability of the soil. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing,

and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIw.

127—Wiota silt loam, loamy substratum, 1 to 3 percent slopes. This nearly level and gently sloping, well drained soil formed in alluvium on low stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 150 acres.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown silty clay loam about 9 inches thick. The subsoil is brown, friable silty clay loam about 31 inches thick. The substratum is dark yellowish brown sandy loam with dark grayish brown and grayish brown mottles.

Permeability is moderate in the upper part of the soil and rapid in the lower part. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction is typically slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and low in available potassium. Tilth generally is good.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of wind erosion in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on alluvial flood plains and in narrow drainageways in uplands. It is subject to occasional flooding (fig. 7). Individual areas are irregular or long and range from 20 to several hundred acres.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 31 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is olive gray, friable silty clay loam about 13 inches thick. The substratum is olive gray silty clay loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 7.0 percent. Reaction is typically neutral or slightly acid in the surface layer. The subsurface layer is medium in available phosphorus and very low in available potassium. Tilth is generally fair unless the soil is worked when too wet.



Figure 7.—An area of Colo, Nevin, and Wiota soils along Prairie Creek. The Colo soils are flooded. The foreground is Fayette soils.

Many areas are cropland. Some are pastureland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. It is poorly drained, however, and is subject to frequent flooding. Artificial drainage is needed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

159—Finchford loamy sand, 0 to 2 percent slopes.

This nearly level, excessively drained soil is on high alluvial flood plains along the major rivers. It is subject to rare flooding. Individual areas are irregular in shape and range from 20 to several hundred acres.

Typically, the surface layer is very dark brown loamy sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy sand about 11 inches thick. The subsoil is dark brown, loose sand about 18 inches

thick. The substratum is very dark grayish brown loamy sand.

Permeability is very rapid. Surface runoff is slow. The available water capacity is low. The organic matter content in the plow layer is 1.0 to 1.5 percent. Reaction in the surface layer is generally medium acid or slightly acid unless the soil has been limed in the last 5 years. The subsoil is generally very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are pastureland. A few are cultivated. This soil is poorly suited to cultivated crops and to hay and pasture. It is poorly or moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Yields for all crops are low, even under good management, unless rainfall is above average and timely. This soil is subject to infrequent flooding. Wind erosion is a hazard in cultivated areas. Conservation tillage and winter cover crops reduce wind erosion. Returning crop residue or adding other organic material helps to maintain fertility and reduce soil loss caused by wind erosion.

This soil is poorly suited to grasses and legumes for hay and pasture. If it is used for hayland or pastureland,

however, there is little hazard of wind erosion. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IVs.

162B—Downs silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on moderately wide ridgetops in loess covered uplands. Individual areas are irregular in shape and range from 20 to 200 acres or more.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is friable silty clay loam about 42 inches thick. The upper and middle parts are brown and dark yellowish brown, and the lower part is mottled brown and yellowish brown. The substratum is mottled brown and yellowish brown silt loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 2.0 to 3.0 percent. Reaction is generally medium acid or strongly acid in the surface layer unless the soil has been limed in the last 5 years. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is generally good, but the soil puddles readily.

Most areas are cultivated. Some are pastureland or hayland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In some places, the use of contouring and terracing to control erosion is difficult because of the irregular contour. In most places, however, these practices are well suited. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

162C—Downs silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridgetops and convex side slopes in uplands. Individual areas are long and irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is friable silty clay loam about 40 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown.

The substratum is brown and yellowish brown silt loam. In some areas part of the surface layer has been removed by erosion.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 2.0 to 3.0 percent. Reaction is generally medium acid or strongly acid in the surface layer unless the soil has been limed in the last 5 years. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is generally good, but the soil puddles readily.

Many areas are pasture or hayland. Some are cultivated. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion is a hazard, however, in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of contouring and terracing to control erosion is difficult because of the irregular contour. In most places, however, these practices are suited. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

162C2—Downs silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow ridgetops and convex side slopes in uplands. Individual areas are generally long and irregular in shape and range from 5 to 75 acres.

Typically, the surface layer is very dark grayish brown silt loam mixed with some dark brown silty clay loam. It is about 7 inches thick. The subsoil is friable silty clay loam about 37 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is brown and yellowish brown silt loam.

Included with this soil in mapping are small areas where most of the surface layer has been removed by erosion. In these areas the organic matter content is lower and tilth is generally poorer than in this Downs soil. These areas are on convex nose slopes and steeper side slopes. They make up about 8 to 10 percent of the unit.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 1.0 to 2.0 percent. Reaction is generally medium acid or strongly acid in the surface layer unless the soil has been limed in the last 5 years. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth generally is fair, but the soil puddles readily.

Most areas are cultivated. Some are pastureland. This soil is moderately suited to cultivated crops and well suited to hay, pasture, and trees. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available potassium and organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in less eroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some areas causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of contouring and terracing to control erosion is difficult because of the irregular contour. In most places, however, these practices are suited. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

162D—Downs silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on convex side slopes in loess covered uplands. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is friable silty clay loam about 38 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam. In some areas the surface layer is thinner and lighter colored because of erosion.

Permeability is moderate. Surface runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is about 1.5 to 2.0 percent. Reaction is typically medium acid or strongly acid in the surface layer unless the soil has been limed in the last 5 years. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is generally good, but the soil puddles readily.

Many areas are pastureland or hayland. Some are cultivated. This soil is moderately suited to cultivated crops and well suited to hay, pasture, and trees. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a severe hazard in cultivated areas. Conservation tillage, winter cover crops, and

grassed waterways reduce soil loss. Limiting the amount of intertilled crops in a rotation system also reduces soil loss. In places the use of contouring or terracing to control erosion is difficult because of the irregular contour. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

162D2—Downs silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes in loess covered uplands. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam mixed with some dark yellowish brown silty clay loam. It is about 7 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Included with this soil in mapping are small areas where most of the surface layer has been removed by erosion. In those areas, organic matter is lower, and tilth generally is poorer than in the Downs soil. Those areas are on convex nose slopes and steeper side slopes. They make up about 8 to 10 percent of the map unit.

Permeability is moderate. Surface runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is about 1.0 to 1.5 percent. Reaction is typically medium acid or strongly acid unless the soil has been limed in the past 5 years. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth generally is fair, but the soil puddles readily.

Most areas either are cultivated or were cultivated in the past and are now pasture or hayland. This soil is moderately suited to cultivated crops and well suited to hay, pasture, and trees. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available potassium and organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in less eroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a severe hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Limiting the amount of intertilled

crops in a rotation system also reduces soil loss. In places contouring or terracing to control erosion is difficult because of the irregular contour. Returning crop residue or the adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIle.

163B—Fayette silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on moderately wide ridgetops in loess covered uplands. Individual areas are long and irregular in shape and range from 5 to 100 acres or more.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown and dark grayish brown silt loam about 5 inches thick. The subsoil is about 36 inches thick. The upper part is brown, friable silt loam; the middle part is brown and dark yellowish brown, friable silty clay loam; and the lower part is yellowish brown, friable, silty clay loam. The substratum is yellowish brown silt loam. In some areas part of the surface layer has been removed by erosion.

Included with this soil in mapping are some nearly level areas on ridgetops that are not so susceptible to erosion. They make up less than 2 percent of the map unit.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 1.5 to 2.5 percent. Reaction is generally medium acid or strongly acid in the surface layer unless the soil has been limed in the last 5 years. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is good, but the soil puddles readily.

Many areas are cultivated. Many are pasture and hayland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of contouring and terracing to control erosion is difficult because of the irregular contour. In most places, however, these practices are suited. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation,

and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

163C—Fayette silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridgetops and convex side slopes in uplands (fig. 8). Individual areas are generally elongated and irregular in shape and range from 5 to 100 acres or more.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown and dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam. In some small areas part of the surface layer has been removed by erosion.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 1.5 to 2.5 percent. Reaction is typically medium acid or strongly acid in the surface layer unless the soil has been limed in the last 5 years. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is good, but the soil puddles readily.

Most areas are pastureland and woodland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of contouring and terracing to control erosion is difficult because of the irregular contour. In most places, however, these practices are suited. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pasture or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

163C2—Fayette silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow ridgetops and convex side slopes in loess covered uplands. Individual areas are generally long and irregular in shape and range from 5 to 100 acres or more.

Typically, the surface layer is brown silt loam with some mixing of dark yellowish brown silty clay loam and is about 8 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.



Figure 8.—Typical landscape in the Fayette-Downs association. Fayette soils are on the side slopes, and Downs soils are on the ridgetops. Nodaway and Radford soils are along the drainageways.

Included with this soil in mapping are small areas where most of the surface layer has been removed by erosion. In those areas, the organic matter content is lower and tilth is generally poorer than in this Fayette soil. Those areas are on the steeper parts of side slopes and on convex nose slopes. They make up about 8 to 12 percent of the map unit.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction is typically medium acid or strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is poor, and the soil puddles readily.

Most areas are cultivated or were cultivated in the past. This soil is moderately suited to cultivated crops and well suited to hay, pasture, and trees. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available potassium and organic matter, has

been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in less eroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of contouring and terracing to control erosion is difficult because of the irregular contour. In most places, however, these practices are suited. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

163D—Fayette silt loam, 9 to 14 percent slopes.

This strongly sloping, well drained soil is on narrow ridgetops and convex side slopes in loess covered uplands. Individual areas are long and irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Permeability is moderate. Surface runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is about 1.0 to 1.5 percent. Reaction is typically medium acid or strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is good, but the soil puddles readily.

Most areas are in pastureland and woodland. This soil is moderately suited to cultivated crops and well suited to hay and pasture and to trees. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. If this soil is cultivated, erosion is a severe hazard. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Limiting the amount of intertilled crops in a rotation system also reduces soil loss. In places the use of contouring or terracing to control erosion is difficult because of the irregular contour. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

163D2—Fayette silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on narrow ridgetops and convex side slopes in loess covered uplands (fig. 9). Individual areas are long and irregular in shape and range from 20 to 200 acres.

Typically, the surface layer is brown silt loam with some mixing of dark yellowish brown silty clay loam and is about 8 inches thick. The subsoil is friable silty clay loam about 30 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Included with this soil in mapping are small areas where most of the surface layer has been removed by erosion. In those areas organic matter content is lower and tilth is generally poorer than in this Fayette soil.

Those areas are on the steeper parts of side slopes and on convex nose slopes. They make up about 5 to 8 percent of the map unit.

Permeability is moderate. Surface runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction is typically medium acid or strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is poor, and the soil puddles readily.

Most areas are cultivated or were cultivated in the past and are now used for pasture or hayland. This soil is moderately suited to cultivated crops and well suited to hay and pasture and trees. It is moderately suited or well suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available potassium and organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. If this soil is cultivated, erosion is a severe hazard. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Limiting the amount of intertilled crops in a rotation system also reduces soil loss. In places the use of contouring or terracing to control erosion is difficult because of the irregular contour. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

163E—Fayette silt loam, 14 to 18 percent slopes.

This moderately steep, well drained soil is on long, convex side slopes in loess covered uplands. Individual areas are irregular in shape and generally range from 20 to 200 acres or more.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 31 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Permeability is moderate. Surface runoff is rapid. The available water capacity is high. The organic matter content in the plow layer is less than 1.0 percent. Reaction



Figure 9.—An area of moderately sloping and strongly sloping Fayette soils, moderately eroded. Nodaway and Radford soils are along the drainageways.

is typically medium acid or strongly acid in the surface layer and subsoil. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is good, but the soil puddles readily.

Most areas are pastureland and woodland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture and trees. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. There is a severe hazard of erosion in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Limiting the amount of intertilled crops in a rotation system also reduces soil loss. In places the use of contouring or terracing to control erosion is difficult because of irregular contour. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rota-

tion, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IVe.

163E2—Fayette silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on long, convex side slopes in loess covered uplands. Individual areas are irregular in shape and generally range from 20 to 200 acres.

Typically, the surface layer is brown silt loam with some mixing of dark yellowish brown silty clay loam and is about 8 inches thick. The subsoil is friable silty clay loam about 28 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Included with this soil in mapping are small areas where most of the surface layer has been removed by erosion. In those areas organic matter content is lower and tilth is generally poorer than in this Fayette soil. Those areas are on the steeper parts of side slopes and on convex nose slopes. They make up about 5 to 8 percent of the map unit.

Permeability is moderate. Surface runoff is rapid. The available water capacity is high. The organic matter con-

tent in the plow layer is less than 0.5 percent. Reaction is typically medium acid or strongly acid in the surface layer and upper part of the subsoil. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth commonly is poor, and the soil puddles readily.

Most areas have been cultivated but are now pasture or hayland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture and trees. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available potassium and in organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a severe hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Limiting the amount of intertilled crops in a rotation system also reduces soil loss. In places the use of contouring or terracing to control erosion is difficult because of the irregular contour. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IVe.

163F—Fayette silt loam, 18 to 25 percent slopes.

This steep, well drained soil is on long, convex side slopes in loess covered uplands. Individual areas are irregular in shape and generally range from 30 to 300 acres.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 29 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Permeability is moderate. Surface runoff is rapid. The available water capacity is high. The organic matter content in the plow layer is less than 1.0 percent. Reaction is typically medium acid or strongly acid in the surface layer and subsoil. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is good, but the soil puddles readily.

Most areas are pastureland and woodland. This soil is poorly suited to cultivated crops and to hay and is mod-

erately suited to pasture and trees. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. If this soil is cultivated, there is a very severe hazard of erosion.

This soil is moderately suited to grasses and legumes for pasture but is poorly suited to hay. Slope makes harvesting hay difficult. If this soil is used for pastureland or woodland, there is little hazard of erosion. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is VIe.

163F2—Fayette silt loam, 18 to 25 percent slopes, moderately eroded. This steep, well drained soil is on long, convex side slopes in loess covered uplands. Individual areas are irregular in shape and generally range from 20 to 200 acres.

Typically, the surface layer is brown silt loam with some mixing of dark yellowish brown silty clay loam and is about 6 inches thick. The subsoil is friable silty clay loam about 28 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Included with this soil in mapping are small areas where most of the surface layer has been removed by erosion. In those areas the organic matter content is lower and tilth is commonly poorer than in this Fayette soil. Those areas are on the steeper parts of side slopes and on convex nose slopes. They make up about 5 to 8 percent of the map unit.

Permeability is moderate. Surface runoff is rapid. The available water capacity is high. The organic matter content in the plow layer is less than 0.5 percent. Reaction is typically medium acid or strongly acid in the surface layer and upper part of the subsoil. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is poor, and the soil puddles readily.

Most areas have been cultivated but nearly all are now pastureland. This soil is poorly suited to cultivated crops and to hay and is moderately suited to pasture and trees. It is poorly suited to most engineering uses.

This soil is poorly suited to cultivated crops because of steep slopes and very severe erosion hazard.

This soil is poorly suited to grasses and legumes for hay because steep slopes make harvesting difficult. It is moderately suited to grasses and legumes for pasture. Careful management is needed to maintain good stands. Because material from the subsoil, which is very low in available potassium and in organic matter, has been mixed into the plow layer, more fertilizer is needed to establish a pasture seeding than would be needed in an uneroded area. Because the clay content in the surface layer is high and the organic matter content is lower than

in uneroded soils, preparing a suitable seedbed is more difficult. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing help to keep the pasture and soil in good condition.

This soil is moderately suited to trees. If it is used for trees, there is little hazard of erosion.

The capability subclass is VIe.

163G—Fayette silt loam, 25 to 40 percent slopes.

This very steep, well drained soil is on long, convex side slopes in loess covered uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 28 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Permeability is moderate. Surface runoff is very rapid. The available water capacity is high. The organic matter content in the surface layer is less than 0.5 percent. Reaction is typically medium acid or strongly acid in the surface layer and upper part of the subsoil. The subsoil is generally high in available phosphorus and very low in available potassium. Tilth generally is good, but the soil puddles readily.

Most areas are woodland or pastureland. This soil is poorly suited to cultivated crops and to hay and is moderately suited to pasture and trees. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. If it is cultivated, there is a very severe hazard of erosion.

This soil is moderately suited to grasses and legumes for pasture but is poorly suited to hay. Harvesting hay is difficult because of the slope. If the soil is used for pastureland or woodland, there is little hazard of erosion. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is VIIe.

171B—Bassett loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is about 37 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown and yellowish brown, firm loam; and the lower part is mottled grayish brown and yellowish brown, firm loam. The substratum is mot-

tled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of this difference in permeability, water tends to move laterally, and seepy areas may develop for short periods in wet seasons. Runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 2.0 to 3.0 percent. Reaction of the surface layer is medium acid to very strongly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good.

Many areas are cropland. Some are hayland, pastureland, and woodland. This soil is well suited to crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, seepy areas may develop unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

171C—Bassett loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is dark brown loam about 3 inches thick. The subsoil is about 35 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is yellowish brown, firm loam. The substratum is mottled yellowish brown loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are areas where the surface layer is thinner and the organic matter content is lower than in this Bassett soil. Those areas are on the steepest part of slopes and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of this difference in permeability, water tends to move laterally, and seepy areas may develop for short periods in wet seasons. Surface runoff is medium. The available water capacity is high. The organic matter content in the

plow layer is 2.0 to 2.5 percent. Reaction in the surface layer is medium acid to very strongly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and very low in available potassium. Tilth generally is good.

Many areas are cropland. Some are hayland, pastureland, and woodland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, seepy spots may develop unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland and pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

171C2—Bassett loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam with some mixing of brown loam and is about 8 inches thick. The subsoil is about 32 inches thick. The upper part is brown, friable loam, and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are small areas where most or all of the original surface layer has been lost through erosion. In those areas the organic matter content is lower than in this Bassett soil. Those areas are on the steepest part of side slopes and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate but the soil is more permeable in the upper part than in the lower part. Because of the difference in permeability, water tends to move laterally, and seepy areas may develop for short periods in wet seasons. Runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 1.5 to 2.0 percent. Reaction in the surface layer is generally medium acid to very strongly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and very low in available potassium. Tilth generally is poor.

Most areas are cropland. This soil is moderately suited to row crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available phosphorus and available potassium and in organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in less eroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, seepy spots may develop unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep pasture and soil in good condition.

The capability subclass is IIIe.

171D—Bassett loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark brown loam about 6 inches thick. The subsurface layer is dark brown loam about 5 inches thick. The subsoil is about 32 inches thick. The upper part is dark yellowish brown, friable loam; the middle part is yellowish brown, friable loam; and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are areas where the surface layer is thinner and the organic matter content is lower. Those areas are on the steepest part of slopes and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part and substratum. Because of the difference in permeability, water tends to move laterally, and seepy areas may develop for short periods in wet seasons. Runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is 1.5 to 2.0 percent. Reaction in the surface layer is generally medium acid to very strongly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and very low in available potassium. Tilth generally is good.

Most areas are hayland, pastureland, or woodland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, seepy spots may develop unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep pasture and soil in good condition.

The capability subclass is IIIe.

171D2—Bassett loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam with some mixing of dark brown loam and is about 7 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is yellowish brown, firm loam. The substratum is mottled grayish brown and yellowish brown loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are small areas where nearly all of the surface layer has been removed by erosion. In those areas the organic matter content is lower than in this Bassett soil. Those areas are on the steepest part of side slopes and convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, but the soil is more permeable in the upper part than in the lower part. Because of the difference in permeability, water tends to move laterally, and seepy areas may develop for short periods in wet seasons. Surface runoff is moderately rapid. The available water capacity is high. The organic matter content in the plow layer is 1.0 to 1.5 percent. Reaction in the surface layer is generally medium acid to very strongly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is poor, and the soil is commonly cloddy.

Most areas are cropland. Some are pastureland or hayland. This soil is moderately suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available phosphorus and available potas-

sium and in organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. If this soil is contoured or terraced, seepy spots may develop unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is moderately suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep pasture and soil in good condition.

The capability subclass is IIIe.

175—Dickinson fine sandy loam, 0 to 2 percent slopes. This nearly level, well drained and somewhat excessively drained soil is on benches and upland ridgetops. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 18 inches thick. The upper part is dark brown, very friable fine sandy loam, and the lower part is dark yellowish brown, very friable loamy sand. The substratum is yellowish brown loamy sand. In some areas on stream benches, coarse sand and gravel are below 4 feet.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 1.5 to 2.5 percent. Reaction in the surface layer is generally slightly acid or medium acid. The subsoil is generally very low in available phosphorus and available potassium. Tilth generally is good.

Most areas are cropland. Some areas are hayland or pasture. This soil is moderately suited to cultivated crops, small grain, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Yields are below average if rainfall is low during July and August. Wind erosion is a hazard in cultivated areas. Conservation tillage and winter cover crops reduce wind erosion. Returning crop residue or adding other organic material helps to maintain tilth and fertility and to reduce wind erosion.

This soil is moderately suited to hay and pasture. There is little hazard of erosion on pastureland or hay-

land. The carrying capacity for pasture is slightly reduced because of droughtiness during dry spells.

The capability subclass is II_s.

175B—Dickinson fine sandy loam, 2 to 5 percent slopes. This gently sloping, well drained and somewhat excessively drained soil is on upland ridgetops and on high stream benches. Individual areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is about 15 inches thick. The upper part is dark yellowish brown and brown, very friable fine sandy loam, and the lower 5 inches is dark yellowish brown, very friable loamy sand. The substratum is yellowish brown and brown sand and loamy sand. In some areas on stream benches, coarser sand and gravel is below 4 feet.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 1.0 to 1.5 percent. Reaction in the surface layer is generally slightly acid or medium acid. The subsoil is generally very low in available phosphorus and available potassium. Tilth generally is good.

Most areas are cropland. Some are hayland or pasture. This soil is moderately suited to cultivated crops, small grain, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Yields are below average if rainfall is low during July and August. There is a hazard of both wind and water erosion in cultivated areas. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce soil loss by wind and water. Terraces may be difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and to reduce erosion.

This soil is moderately suited to hay and pasture. There is little hazard of erosion on pastureland or hayland. The carrying capacity for pasture is slightly limited because of droughtiness during dry spells.

The capability subclass is II_e.

175C—Dickinson fine sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained and somewhat excessively drained soil is on convex ridges and side slopes in uplands and on high stream benches. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 13 inches thick. The subsoil is about 14 inches thick. The upper part is dark brown, very friable fine sandy loam, and the lower part is dark yellowish brown, very friable loamy sand. The substratum is yellowish brown loamy sand. In some areas on stream benches, coarse sand and gravel is below 4 feet.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is medium. The available water capacity is moderate. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction in the surface layer is generally slightly acid or medium acid. The subsoil is generally very low in available phosphorus and available potassium. Tilth generally is good.

Many areas are cropland. Some are hayland or pasture. This soil is poorly suited to cultivated crops and moderately suited to hay, pasture, and trees. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Yields are below average if rainfall is low during July and August. There is a hazard of both wind and water erosion in cultivated areas. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce soil loss by wind and water. Limiting the amount of row crops in a rotation system reduces soil loss. Terraces may be difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and to reduce erosion.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion, however, on pastureland or hayland. The carrying capacity for pasture is limited because of droughtiness during dry spells.

The capability subclass is III_e.

177—Saude loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces along rivers and streams. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 14 inches thick. The upper part is brown, friable loam, and the lower part is dark yellowish brown, very friable loamy sand. The substratum is dark yellowish brown and yellowish brown gravelly sand.

Permeability is moderate in the upper part of the soil and very rapid in the lower part. Surface runoff is slow. The available water capacity is low to moderate. The organic matter content in the plow layer is 2.5 to 3.5 percent. Reaction is generally medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is good.

Most areas are cropland. Some are pastureland or hayland. This soil is moderately suited to cultivated crops and to grasses and legumes. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is droughty in years when rainfall is below average and during hot dry periods in summer. There is some hazard of wind erosion in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. Pasture may be limited during hot dry periods. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is II_s.

177B—Saude loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on benches along rivers and streams. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 5 inches thick. The subsoil is about 14 inches thick. It is brown, friable loam in the upper and middle parts and dark yellowish brown, very friable sandy loam in the lower 2 inches. The substratum is dark yellowish brown and yellowish brown gravelly sand.

Permeability is moderate in the upper part of the soil and very rapid in the lower part. Surface runoff is medium. The available water capacity is low to moderate. The organic matter content in the plow layer is 2.5 to 3.0 percent. Reaction in the surface layer is generally medium acid unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally good.

Most areas are cropland, but some are pastureland or hayland. This soil is moderately suited to crops and to grasses and legumes. It is well suited or moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is droughty in years when rainfall is below average and during hot dry periods in summer. There is some hazard of erosion in cultivated areas. Conservation tillage and winter cover crops reduce soil loss. Erosion control practices, such as contouring and terracing, may be difficult to use in most areas because of irregular contour and short slopes. Terracing exposes the coarse textured substratum. Unless topsoil is placed over the areas of exposed substratum, those areas are very droughty. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Pasture may be limited during hot dry periods. Overgrazing or grazing when the soil is wet compacts the soil and results in poorer tilth and increased runoff. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is II_e.

177C—Saude loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on stream benches along rivers and streams, commonly on the bench

escarpment. Individual areas are generally long and narrow and range from 10 to 50 acres.

Typically, the surface layer is very dark brown loam about 11 inches thick. The subsoil is brown, friable loam about 13 inches thick. The substratum is yellowish brown gravelly sand. In some places, the surface layer is as thin as 7 inches because of erosion.

Included with this soil in mapping are areas where sand or gravel is at or near the surface. Those areas are more droughty than this Saude soil. They are on the steepest part of the slopes. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of this soil and very rapid in the lower part. Surface runoff is medium. The available water capacity is low to moderate. The organic matter content in the plow layer is 2.0 to 2.5 percent. Reaction is generally medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is good.

Most areas are cropland. Some are pastureland or hayland. This soil is poorly suited to cultivated crops and moderately suited to grasses and legumes. It is moderately or poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Because it is droughty, yields are low unless rainfall is timely. Erosion is a hazard in cultivated areas. Conservation tillage and winter cover crops reduce soil loss. Erosion control practices, such as contouring or terracing, are difficult to use because of the irregular contour and short slopes. Terracing exposes the coarse textured substratum in areas. These areas are very droughty unless topsoil is placed over them. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Pasture is limited during hot dry periods. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth and increased runoff. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is III_e.

178—Waukee loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream benches along rivers and major streams. Individual areas are irregular in shape and range from 5 to 100 acres or more.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark brown loam about 8 inches thick. The subsoil is friable loam about 21 inches thick. The upper part is very dark grayish brown and brown, and the lower part is dark yellowish brown. The substratum is yellowish brown coarse sand.

Included with this soil in mapping are a few areas that are more droughty than this Waukee soil because sandy

material is at or near the surface. Those areas are on slight rises. They make up less than 2 percent of the map unit.

Permeability is moderate in the upper part of this Waukee soil and very rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction in the surface layer is generally slightly acid. The subsoil is generally low in available phosphorus and very low in available potassium. Tilth is good.

Almost all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to many engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of wind erosion in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is II_s.

178B—Waukee loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream benches along rivers and major streams. Individual areas are irregular in shape and range from 5 to 200 acres or more.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 11 inches thick. The subsoil is friable loam about 19 inches thick. The upper part is brown, and the lower part is yellowish brown. The substratum is yellowish brown coarse sand with some gravel.

Included with this soil in mapping are areas where sandy and gravelly material is at or near the surface. Those areas are on the steepest part of slopes. They are more droughty than this Waukee soil. They make up 2 to 5 percent of the map unit.

Permeability is moderate in the upper part of this Waukee soil and very rapid in the lower part. Surface runoff is medium. The available water capacity is moderate. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction in the surface layer is generally slightly acid. The subsoil is generally low in available phosphorus and very low in available potassium. Tilth is good.

Almost all areas are cropland. This soil is moderately suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In many places

the use of erosion control practices, such as contouring and terracing, is difficult because of complex contours and short slopes. Terracing may expose the coarse textured substratum. Areas of exposed substratum are very droughty. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is II_e.

184B—Klinger silty clay loam, 1 to 4 percent slopes. This nearly level to gently sloping, somewhat poorly drained soil is on upland ridges and around the heads of drainageways. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is dark brown and very dark brown silty clay loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is dark grayish brown, friable silty clay loam, and the lower part is yellowish brown, firm loam. The substratum is yellowish brown loam. In some areas the loess is 40 to 48 inches thick over loam glacial till.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction in the surface layer is generally slightly acid. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good unless the soil has been worked when too wet.

Almost all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a slight hazard in cultivated areas. The soil may be subject to overwash from higher lying soils. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In many places using erosion control practices, such as contouring or terracing, is difficult because of the complex contours. If this soil is terraced, tile drainage is needed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is II_e.

198B—Floyd loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is in con-

cave positions at the heads of drainageways or on concave side slopes along drainageways. Individual areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 15 inches thick. The subsoil is about 38 inches thick. The upper 7 inches is dark grayish brown, friable loam with grayish brown and yellowish brown mottles. The middle part is grayish brown, friable, light sandy clay loam and sandy loam. The lower part is yellowish brown and grayish brown, firm loam. The substratum is mottled yellowish brown and grayish brown loam. In some areas the surface layer is sandy loam. In some unimproved areas stones and boulders are at or near the surface.

Included with this soil in mapping are a few areas where 6 to 20 inches of lighter colored recent overwash has been deposited. The recent material is lower in organic matter than this Floyd loam. These areas are adjacent to areas of steeper soils that surround the Floyd soils. They make up 2 to 5 percent of the map unit.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction in the surface layer is generally neutral. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good unless the soil is worked when too wet.

Many areas are cropland. Some are pastureland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Artificial drainage, however, is needed. Because wetness is partly caused by hillside seepage, a drainage system that intercepts laterally moving water is best. In some areas erosion is a problem. Terraces reduce erosion but should be combined with tile drains for best results. Some areas have never been cropped because stones and boulders are at or near the surface.

This soil is well suited to grasses and legumes for pasture or hay. Removing rocks and installing tile are beneficial on pastureland and necessary on hayland. Overgrazing or grazing when the soil is too wet compacts the soil, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing when the soil is wet are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

207C—Whalan loam, 20 to 30 inches to limestone, 2 to 9 percent slopes. This gently sloping and moderately sloping, well drained soil is on ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark grayish brown loam about 2 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is about 23 inches thick. The upper and middle parts are dark yel-

lowish brown, friable loam, and the lower 2 inches is dark yellowish brown, firm silty clay. Shattered, fractured limestone bedrock is at a depth of 28 inches.

Included with this soil in mapping are a few areas where limestone bedrock is at the surface. Those areas are on the short, steeper part of the slope, generally near a drainageway. They make up less than 2 percent of the map unit.

Permeability is moderate in the upper part of this Whalan soil and moderately slow in the zone just above the limestone. Surface runoff is medium. The available water capacity is low. The organic matter content in the plow layer is 0.5 to 1.0 percent. Reaction is usually medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good.

Many areas are cropland. Some are pastureland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain because of the moderate depth to bedrock. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, grassed waterways, and contouring help to prevent excessive soil loss. Terracing is difficult because of the moderate depth to bedrock. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is wet compacts the surface and increases runoff. Pasture rotation and proper stocking are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

214C—Rockton loam, 20 to 30 inches to limestone, 2 to 9 percent slopes. This gently sloping and moderately sloping, well drained soil is on ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 70 acres.

Typically, the surface layer is very dark brown loam about 6 inches thick. The subsurface layer is very dark grayish brown and dark brown loam about 11 inches thick. The subsoil is about 9 inches thick. The upper part is brown, friable loam, and the lower 2 inches is dark yellowish brown, firm clay. Shattered and fractured limestone bedrock is at a depth of 26 inches. In a few areas part of the surface layer has been removed by erosion.

Included with this soil in mapping are a few areas where the limestone bedrock is at the surface. Those areas are on the short, steeper part of the slopes, generally near a drainageway. They make up less than 2 percent of the map unit.

Permeability is moderate. Surface runoff is medium. The available water capacity is low. The organic matter content in the plow layer is about 2.5 to 3.5 percent.

Reaction in the surface layer is commonly slightly acid or medium acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are cropland. A few are pastureland. This soil is poorly suited to cultivated crops and moderately suited to grasses and legumes for hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain because of moderate depth to bedrock. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, grassed waterways, and contouring help to prevent excessive soil loss. Terracing is difficult because of the moderate depth to bedrock. Returning crop residue or other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is wet compacts the surface and increases runoff. Pasture rotation and proper stocking are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

220—Nodaway silt loam, 0 to 2 percent slopes.

This nearly level, moderately well drained soil is on recently formed alluvial flood plains along rivers, streams, and narrow upland drainageways. It is subject to frequent flooding. Individual areas are irregular or long and range from 20 to 200 acres or more.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The substratum is stratified dark grayish brown and very dark grayish brown silt loam.

Included with this soil in mapping are somewhat poorly drained areas that may require supplemental drainage. Those areas are in depressions or old stream channels. They make up less than 2 percent of the map unit.

Permeability is moderate in this Nodaway soil. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 2.0 to 3.0 percent. Reaction in the surface layer is generally neutral or slightly acid. The substratum is medium in available phosphorus and available potassium. Tilth is good.

Many areas on the wider flood plains are cropland. Most in the narrow drainageways are pastureland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. It is subject to frequent flooding. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the soil and pasture in good condition.

The capability subclass is IIw.

221B—Palms muck, 1 to 4 percent slopes. This gently sloping, very poorly drained soil generally occurs as hillside seeps at the base of slopes or in upland drainageways. Some areas are on stream benches. Some areas are subject to frequent flooding. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is black, very friable muck about 10 inches thick. The subsurface layer is black muck about 16 inches thick. The substratum is black silt loam to a depth of 32 inches and dark gray silt loam to a depth of 52 inches.

Included with this soil in mapping are areas where muck is 72 inches or more thick over the substratum. Those areas are on landscape positions similar to those of this Palms soil. They make up as much as 15 percent of the map unit.

Permeability is moderate and moderately slow. Surface runoff is very slow. The available water capacity is high. The organic matter content in the plow layer is more than 20 percent. Reaction in the surface layer is generally neutral or slightly acid. This soil is very low in available phosphorus and available potassium.

Most areas are pastureland or wasteland. This soil is poorly suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain unless it is drained. Draining it is difficult because water moves to areas of this soil in the coarse textured layers below the organic material. The water must be intercepted before it reaches areas of this soil. Locating the coarse textured layers and placing the tile properly are difficult.

This soil is poorly suited to grasses and legumes for hay and pasture unless it is drained.

The capability subclass is IIIw.

226—Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on benches along streams and rivers. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is loam about 13 inches thick. The upper part is very dark gray and the lower part is very dark grayish brown. The subsoil is about 17 inches thick. The upper 9 inches is dark grayish brown, friable loam with yellowish brown mottles. The middle 4 inches is dark grayish brown, friable sandy loam with yellowish brown mottles. The lower 4 inches is dark yellowish brown, very friable gravelly sand. The substratum is yellowish brown and brown sand and gravelly sand.

Included with this soil in mapping are areas where depth to sand and gravel is as little as 24 inches. These areas may be slightly droughty during dry periods. They

are generally on the slightly higher rises. They make up as much as 15 percent of the map unit.

Permeability is moderate in the upper part of this Lawler soil and rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 4.0 to 5.0 percent. Reaction in the surface layer is generally slightly or medium acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth generally is good unless the soil has been worked when too wet.

Most areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of soil blowing in cultivated areas. Areas that are shallower to sand and gravel are slightly droughty during extended dry periods. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Surface compaction and poor tilth can result, however, from overstocking or from grazing during wet periods. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

284—Flagler sandy loam, 0 to 2 percent slopes.

This nearly level, somewhat excessively drained soil is on benches along streams and rivers. Individual areas are irregular in shape and range from 10 to 100 acres or more.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown sandy loam about 15 inches thick. The subsoil is about 13 inches thick. The upper part is dark yellowish brown, very friable sandy loam, and the lower part is brown, loose gravelly sand. The substratum is brown sand with some gravel.

Permeability is moderately rapid in the upper part of the soil and very rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 1.5 to 2.5 percent. Reaction in the surface layer is generally slightly acid or medium acid unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is good.

Most areas are pastureland or hayland. Some are cropland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Soil blowing is a hazard in cultivated areas. The soil is droughty in years when rainfall is below average and during hot dry periods in summer. Minimum tillage and winter cover crops help to prevent soil blowing.

Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. Pasture is limited during hot dry periods. Overgrazing or grazing when the soil is wet compacts the soil and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIs.

284B—Flagler sandy loam, 2 to 5 percent slopes.

This gently sloping, somewhat excessively drained soil is on benches along rivers and streams. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown sandy loam about 12 inches thick. The subsoil is about 12 inches thick. The upper part is dark yellowish brown, very friable sandy loam, and the lower part is dark yellowish brown, loose gravelly sand. The substratum is yellowish brown sand with some gravel.

Permeability is moderately rapid in the upper part of the soil and very rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 1.0 to 1.5 percent. Reaction in the surface layer is usually slightly acid or medium acid unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is good.

Most areas are pastureland or hayland. Some are cropland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Because of droughtiness, yields are low unless rainfall is average or above average and very timely. There is some hazard of erosion in cultivated areas. Conservation tillage and winter cover crops reduce soil loss. Erosion control practices, such as contouring or terracing, may be difficult to use because of irregular contours and short slopes. Terracing exposes the coarse textured subsoil or substratum. These coarse textured areas are very droughty unless topsoil is placed over them. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Production of pasture and hay is limited during hot dry periods. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth and increased runoff. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIs.

285C—Burkhardt sandy loam, 2 to 9 percent slopes.

This gently sloping to moderately sloping, some-

what excessively drained soil is on upland knolls and stream escarpments. Individual areas are irregular in shape and range from 5 to 10 acres.

Typically, the surface layer is very dark brown sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown sandy loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown, friable sandy loam; the middle part is brown, very friable gravelly loamy sand; and the lower part is strong brown, very friable gravelly sand. The substratum is brown and strong brown gravelly sand.

Included with this soil in mapping are areas where the surface layer is lighter colored or thinner. These areas generally are on upland knobs. They make up about 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Surface runoff is medium. The available water capacity is very low. The organic matter content in the plow layer is about 0.5 to 1.5 percent. Reaction in the surface layer is generally slightly acid to strongly acid unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is good.

Most areas are pastureland or hayland, the best use for this soil. Some are cropland because the management of this soil is typically determined by that of the surrounding soils. This soil is poorly suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Erosion is a hazard on cultivated areas. The soil is also very droughty. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. The use of contouring or terracing is difficult because of the short, irregular slopes. In addition, terracing exposes coarse textured material. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is poorly suited to grasses and legumes for hay and pasture. Because of the very low available water capacity, production is very low during summer months. The soil is better suited to hay or pasture, however, than to row crops.

The capability subclass is IVs.

291—Atterberry silt loam, 1 to 3 percent slopes.

This nearly level, somewhat poorly drained soil is on nearly level, broad loess covered areas in uplands or in areas around the heads of drainageways. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 34 inches thick. The upper 5 inches is brown, and the rest is grayish brown with yellowish brown and strong brown mottles. The substratum is grayish brown silt loam.

Permeability is moderate and moderately slow. Runoff is slow (fig. 10). The available water capacity is high. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction in the surface layer is generally slightly acid or medium acid if the soil has not been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is fair unless the soil is worked when too wet.

Most areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Because it is somewhat poorly drained soil, tile drains may be needed for timely field operations. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

293C—Chelsea-Lamont-Fayette complex, 5 to 9 percent slopes. This map unit consists of gently rolling, excessively drained and well drained soils on upland ridges and side slopes. Individual areas range from 20 to several hundred acres.

This unit is about 40 percent Chelsea soils, 30 percent Lamont soils, 20 percent Fayette soils, and 10 percent included soils. Areas of these soils are so intricately mixed or are so small that it is not practical to map them separately.

Typically, the surface layer of the Chelsea soil is dark brown loamy fine sand about 4 inches thick. The subsurface layer is brown, yellowish brown, and dark yellowish brown fine sand about 37 inches thick. The next layer is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick.

Typically, the surface layer of the Lamont soil is very dark gray fine sandy loam about 3 inches thick. The subsurface layer is brown fine sandy loam about 5 inches thick. The subsoil is very friable sandy loam about 26 inches thick. The upper part is dark yellowish brown and the lower part is dark brown and yellowish brown. The substratum is yellowish brown fine sand.

Typically, the surface layer of the Fayette soil is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown and dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Included with these soils in mapping are small areas which are slightly less fertile because part of the surface layer has been removed by erosion. These included



Figure 10.—An area of the somewhat poorly drained Atterberry soils surrounded by the better drained Downs soils just after a rain.

areas are on the steepest part of the slopes. They make up about 15 percent of the map unit.

Permeability is rapid in the Chelsea soil, moderately rapid in the upper part of the Lamont soil and very rapid in the lower part, and moderate in the Fayette soil. Surface runoff is medium in all these soils. The available water capacity is low in the Chelsea and Lamont soils and high in the Fayette soil. The organic matter content in the plow layer is less than 0.5 percent in the Chelsea and Lamont soils and about 1.0 to 2.0 percent in the Fayette soil. Reaction is generally medium acid or strongly acid in the surface layer of all these soils unless the soil has been limed in the past 5 years. The lower part of the Chelsea soil is very low in available phosphorus and potassium. The subsoil of the Lamont soil is generally medium in available phosphorus and very low in available potassium. The subsoil of the Fayette soil is generally high in available phosphorus and very low in available potassium. Tilth is generally good.

Most areas of this unit are pastureland or woodland. This unit is poorly suited to cultivated crops and moderately suited to hay and pasture. It is moderately or poorly suited to most engineering uses.

This unit is poorly suited to corn, soybeans, and small grain. Yields are low unless rainfall is both above average and timely. Erosion by both wind and water is a hazard in cultivated areas. Conservation tillage, contouring, winter cover crops, and grassed waterways reduce erosion. Terraces may be difficult to construct and maintain because of poor stability. Returning crop residue or adding other organic material helps to maintain fertility and reduce erosion.

This unit is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. The carrying capacity for pasture is limited during midsummer because of droughtiness.

The capability subclass is IIIe.

293D—Chelsea-Lamont-Fayette complex, 9 to 18 percent slopes. This map unit consists of rolling and hilly, excessively drained and well drained soils on upland ridges and side slopes. Individual areas range from 20 to several hundred acres.

This unit is about 40 percent Chelsea soils, 30 percent Lamont soils, and 20 percent Fayette soils. Areas of

these soils are so intricately mixed or are so small that mapping them separately is not practical.

Typically, the surface layer of the Chelsea soil is brown loamy fine sand about 2 inches thick. The subsurface layer is yellowish brown fine sand about 30 inches thick. The next layer is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick.

Typically, the surface layer of the Lamont soil is dark gray fine sandy loam about 3 inches thick. The subsurface layer is brown fine sandy loam about 4 inches thick. The subsoil is very friable sandy loam about 22 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown fine sand.

Typically, the surface layer of the Fayette soil is dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Included with these soils in mapping are small areas where part of the surface layer has been removed by erosion. These areas are slightly less fertile than surrounding areas. They are on the steepest part of the slopes. They make up about 15 percent of the map unit.

Permeability is moderately rapid in the Chelsea soil, moderately rapid in the upper part of the Lamont soil and very rapid in the lower part, and moderate in the Fayette soil. Surface runoff is moderately rapid on all of these soils. The available water capacity is low in the Chelsea and Lamont soils and high in the Fayette soil. The organic matter content in the plow layer is less than 0.5 percent in the Chelsea and Lamont soils and about 0.5 to 1.0 percent in the Fayette soil. Reaction is generally medium acid or strongly acid in the surface layer of all these soils unless the soil has been limed in the past 5 years. The lower part of the Chelsea soil is very low in available phosphorus and potassium. The subsoil of the Lamont soil is generally medium in available phosphorus and very low in available potassium. The subsoil of the Fayette soil is generally high in available phosphorus and very low in available potassium. Tilth is generally good.

Nearly all areas are pastureland or woodland. This unit is poorly suited to cultivated crops and moderately suited to hay and pasture. It is moderately or poorly suited to most engineering uses.

This unit is poorly suited to corn, soybeans, and small grain. If these soils are cultivated, the hazard of erosion is severe because of slope.

This unit is moderately suited to grasses and legumes for pasture and hay. Many areas are steep enough to cause problems in harvesting hay. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. The carrying capacity for pasture is limited during midsummer because of droughtiness.

Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is Vle.

293F—Chelsea-Lamont-Fayette complex, 18 to 30 percent slopes. This map unit consists of steep and very steep, excessively drained and well drained soils on upland ridges and side slopes. Individual areas range from 20 to 200 acres.

This unit is about 40 percent Chelsea soils, 30 percent Lamont soils, and 20 percent Fayette soils. Areas of these soils are so intricately mixed or are so small that mapping them separately is not practical.

Typically, the surface layer of the Chelsea soil is brown loamy fine sand about 2 inches thick. The subsurface layer is yellowish brown, loose fine sand about 26 inches thick. The next layer is similar to the subsurface layer but has bands of brown, very friable loamy fine sand 1/4 inch to 2 inches thick.

Typically, the surface layer of the Lamont soil is dark gray fine sandy loam about 2 inches thick. The subsurface layer is brown fine sandy loam about 4 inches thick. The subsoil is very friable sandy loam about 20 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown fine sand.

Typically, the surface layer of the Fayette soil is very dark grayish brown silt loam about 2 inches thick. The subsurface layer is very dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 29 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown. The substratum is yellowish brown silt loam.

Permeability is rapid in the Chelsea soil, moderately rapid in the upper part of the Lamont soil and very rapid in the lower part, and moderate in the Fayette soil. Surface runoff is moderately rapid on all of these soils. The available water capacity is low in the Chelsea and Lamont soils and high in the Fayette soil. The organic matter content in the plow layer is less than 0.5 percent in all these soils. Reaction is generally medium acid or strongly acid in the surface layer of all these soils. The lower part of the Chelsea soil is very low in available phosphorus and potassium. The subsoil of the Lamont soil is generally medium in available phosphorus and very low in available potassium. The subsoil of the Fayette soil is generally high in available phosphorus and very low in available potassium. Tilth is generally good.

Nearly all areas are woodland. A few are pastureland. This soil is poorly suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This unit is poorly suited to corn, soybeans, and small grain. If it is cultivated, the hazard of erosion by both wind and water is very severe. Yields are very low.

This unit is poorly suited to hay and pasture. If it is used for pasture, there is little hazard of erosion, but careful management is needed to maintain adequate plant cover.

The capability subclass is VIIe.

302B—Coggon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark grayish brown loam about 4 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 47 inches thick. The upper part is yellowish brown, friable loam; the middle part is strong brown and yellowish brown, firm clay loam; and the lower part is yellowish brown, firm clay loam. The substratum is yellowish brown loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 1.5 to 2.5 percent. Reaction in the surface layer is generally medium acid or strongly acid unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is good.

Most areas are woodland or pastureland. A few are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

302C—Coggon loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam about 3 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is about 42 inches thick. The upper few inches is yellowish brown, friable loam; the middle part is strong brown and yellowish brown, firm clay loam; and the lower part is yellowish brown, firm clay loam. The substratum is yellowish brown loam. In some small areas part of the surface layer has been removed by erosion.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 1.0 to 2.0 percent.

Reaction in the surface layer is generally medium acid or strongly acid unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is good.

Most areas are woodland or pastureland. A few are cropland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

302C2—Coggon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is brown loam with some mixing of yellowish brown loam and is about 7 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown, friable loam; the middle part is strong brown and yellowish brown, firm clay loam; and the lower part is yellowish brown, firm clay loam. The substratum is yellowish brown loam.

Included in mapping are small areas where all of the original surface layer has been removed by erosion. In those areas the organic matter content is lower than in this Coggon soil. Those areas are on the steepest part of the slope and on convex nose slopes. They make up less than 10 percent of the map unit.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction in the surface layer is generally medium acid or strongly acid unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is poor.

Most areas are cultivated or were cultivated in the past. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is low in available phosphorus and very low in available potassium and in organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high

yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Erosion control practices, such as contouring or terracing, may be needed. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to legumes and grasses for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

315—Fluvaquents, sandy and loamy. These nearly level soils consist of recently deposited, highly stratified

sediment that has not been in place long enough for soil horizons to develop. They are frequently flooded, and each flood adds new sediment. The sediment, which varies in texture, is mainly loam, silt loam, sandy loam, and loamy sand.

Much of this unit is channeled and contains low natural levees, small ponds, sloughs, and small oxbows (fig. 11). Natural drainage ranges from very poor and poor in the channels to well drained or excessively drained in the natural levees.

Most areas are wildlife habitat, pastureland, or woodland. The soils are poorly suited to cultivated crops and to hay and pasture. They are poorly suited to most engineering uses.

These soils are poorly suited to corn, soybeans, and small grain. They are subject to frequent flooding. The low areas may remain ponded for considerable lengths of time.

These soils are poorly suited to building site development and onsite waste disposal. They are subject to frequent flooding and have a high water table.

The capability subclass is Vw.



Figure 11.—Typical area of Fluvaquents, sandy and loamy, along the Cedar River showing the many remnants of former stream channels.

350—Waukegan silt loam, 0 to 2 percent slopes.

This nearly level, well drained soil is on stream benches along rivers and major streams. Individual areas are irregular in shape and range from 10 to 100 acres or more.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silt loam about 5 inches thick. The subsoil is about 36 inches thick. The upper part is brown and dark yellowish brown, friable silty clay loam; the middle part is dark yellowish brown, friable silt loam and loam; and the lower part is yellowish brown, loose loamy sand. The substratum is yellowish brown sand.

Included in mapping are areas where depth to sand is as little as 26 inches. These areas are more droughty than this Waukegan soil. They are on slight rises. They make up 5 to 10 percent of the map unit.

Permeability is moderate in the upper part of the soil and rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is about 3.5 to 4.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is good.

Almost all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Because the available water capacity is moderate, the soil is slightly droughty during extended dry spells. There is some hazard of wind erosion in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIs.

350B—Waukegan silt loam, 2 to 5 percent slopes.

This gently sloping, well drained soil is on stream benches along rivers and major streams. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is about 34 inches thick. The upper part is dark yellowish brown, friable silty clay loam; the middle part is dark yellowish brown, friable silt loam and loam, and the lower part is yellowish brown, loose loamy sand. The substratum is yellowish brown sand.

Included in mapping are areas where sand is at a depth of as little as 26 inches. These areas are slightly droughty. They are on the steepest part of the slope. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of the soil and rapid in the lower part. Surface runoff is medium. The available water capacity is moderate. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally good.

Almost all areas are cropland. This soil is moderately suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Because the available water capacity is moderate, the soil is slightly droughty during extended dry spells. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In many places using control erosion practices, such as contouring and terracing, is difficult because of complex contours and short slopes. Terracing may expose areas of the coarse textured material. These areas are very droughty. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

352B—Whittier silt loam, 1 to 4 percent slopes.

This gently sloping, well drained soil is on high stream benches along rivers and major streams. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is about 24 inches thick. The upper and middle parts are dark yellowish brown, friable silty clay loam, and the lower part is dark yellowish brown, friable loam. The substratum is yellowish brown loamy sand.

Permeability is moderate in the upper part of the soil and rapid in the lower part. Surface runoff is medium. The available water capacity is moderate. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth generally is fair.

Most areas are cropland or pastureland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately to poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is slightly droughty in years when rainfall is

below average. There is some hazard of erosion in cultivated areas. Winter cover crops, conservation tillage, and grassed waterways reduce soil loss. Erosion control practices, such as contouring and terracing, may be difficult to use because of the irregular contour and short slopes in most areas. Terracing may expose areas of the coarse textured substratum. These areas are very droughty unless topsoil is placed over them. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth and increased runoff. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

377B—Dinsdale silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape. They range from 10 to several hundred acres and extend across several farms.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 33 inches thick. The upper part is brown, friable silty clay loam, and the lower 9 inches is brown and yellowish brown, firm loam. The substratum is yellowish brown loam. In some areas the depth to the firm loam is less than 24 inches.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 3.0 to 4.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally good.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places contouring or terracing to control erosion is difficult because of complex slopes. In most places, however, these practices are suitable. Terrace cuts should be held to a minimum to avoid exposing glacial till, which has low fertility and poor tilth. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and re-

sults in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

377C—Dinsdale silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable silty clay loam, and the lower part is yellowish brown, firm loam. The substratum is yellowish brown loam. In some areas the surface layer is thinner and the depth to firm loam is less than 24 inches.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 2.5 to 3.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally good.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places contouring or terracing is difficult because of complex slopes. In most places, however, these practices are suitable. Terracing may expose glacial till, which has lower fertility and poor tilth. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIle.

377C2—Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is dark brown silty clay loam with some mixing of brown silty clay loam and is about 8 inches thick. The subsoil is about 25 inches thick. The upper part is brown, friable silty clay loam, and the lower part is yellowish brown, firm loam. The substratum is yellowish brown loam. In some areas firm loam is at or near the surface.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 2.0 to 3.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally fair unless the soil has been worked when too wet.

Nearly all areas are cropland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is well suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is low in available phosphorus and very low in available potassium and in organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, lowers yields and in some cases causes severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places, contouring or terracing is difficult because of irregular contours. In most places, however, these practices are suitable. Terracing may expose glacial till, which has lower fertility and poor tilth. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep pasture and soil in good condition.

The capability subclass is IIIe.

382—Maxfield silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad ridgetops in uplands. Individual areas are irregular in shape and range from 50 to 100 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 13 inches thick. The upper part is black and the lower part is very dark gray. The subsoil is about 29 inches thick. The upper part is dark gray and olive gray, friable silty clay loam; the middle part is light olive gray and yellowish brown, very friable sandy loam; and the lower part is gray and yellowish brown, firm loam. The substratum is gray and yellowish brown loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 6.0 to 7.0 percent. Reaction in the surface layer is generally neutral. The subsoil is very low in available phosphorus and available potassium. Tilth generally is fair unless the soil is worked when too wet.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains are needed. Wind erosion is a slight hazard in cultivated areas. Minimum tillage and winter cover crops reduce the hazard of wind erosion. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture if it is adequately drained. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

391B—Clyde-Floyd complex, 1 to 4 percent slopes.

This map unit consists of gently sloping, poorly drained and somewhat poorly drained, moderately permeable soils. These soils are on upland drainageways. Individual areas range from 100 to several hundred acres and extend across several farms.

This unit is about 60 percent Clyde soils and 40 percent Floyd soils. The Clyde soil is in the lowest part of the drainageways and the Floyd soil along the upper part. The Clyde soil is subject to frequent flooding.

Typically, the surface layer of the Clyde soil is black silty clay loam about 9 inches thick. The subsurface layer is black and very dark gray silty clay loam about 14 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown, olive gray, and dark gray, friable silty clay loam and loam. The middle part is olive gray, very friable sandy loam and loamy sand. The lower part is mottled gray and yellowish brown, firm loam. The substratum is gray and yellowish brown loam.

Typically, the surface layer of the Floyd soil is black loam about 8 inches thick. The subsurface layer is very dark grayish brown and black loam about 15 inches thick. The subsoil is about 38 inches thick. The upper part is dark grayish brown, friable loam. The middle part is grayish brown, friable sandy clay loam and sandy loam with yellowish brown mottles. The lower part is mottled yellowish brown and grayish brown, firm loam. The substratum is mottled yellowish brown and grayish brown loam. In some areas the surface layer is sandy loam.

Included with this unit in mapping are areas of Schley soils, which are more acid and have a thinner surface layer than Clyde and Floyd soils. They are on similar landscape positions. They make up about 10 percent of the map unit.

Permeability is moderate in Clyde and Floyd soils. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 9.0 to 11.0 percent in the Clyde soil and about 5.0 to 6.0 percent in the Floyd soil. Reaction in the surface layer is generally neutral or slightly acid in both soils. The subsoil is very low in available phosphorus and potassium. Tilth is fair to good.

Many areas are cropland and pastureland. This unit is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This unit is well suited to corn, soybeans, and small grain. Tile drainage, however, is needed to utilize the full potential of the unit. Because wetness is partly the result of hillside seepage, a drainage system that intercepts laterally moving water is most successful. Stones and boulders are common in many areas and must be removed before the soil can be cropped. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This unit is well suited to hay or pasture if it is adequately drained and the stones and boulders are removed. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing help to keep pasture and soil in good condition.

The capability subclass is llw.

398—Tripoli clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad upland ridgetops. Individual areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is black clay loam about 7 inches thick. The subsurface layer is black and very dark gray clay loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown, friable clay loam with light olive brown mottles; the middle few inches is olive brown, friable loam; and the lower part is mottled yellowish brown and grayish brown, firm loam. The substratum is yellowish brown and light brownish gray loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 6.0 to 7.0 percent. Reaction is generally neutral or slightly acid in the surface layer. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good unless the soil is worked when wet.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains, however, are needed. Wind erosion is a slight hazard in cultivated areas. Minimum tillage and winter cover crops reduce this hazard. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture if it is adequately drained. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is llw.

399—Readlyn loam, 1 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on moder-

ately wide, slightly convex ridgetops in uplands. Individual areas are irregular in shape and range from 10 to 100 acres or more.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark gray and very dark grayish brown loam about 11 inches thick. The subsoil is about 27 inches thick. The upper 4 inches is brown, friable loam with grayish brown and yellowish brown mottles. The middle 7 inches is mottled grayish brown and yellowish brown, firm loam. The lower part is yellowish brown, firm loam with grayish brown mottles. The substratum is yellowish brown and brown loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 4.5 to 5.5 percent. Reaction is generally slightly acid or medium in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good unless the soil has been worked when too wet.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains may be needed, however, to maintain timely field operations. Wind erosion is a slight hazard in cultivated areas. Conservation tillage and winter cover crops reduce this hazard. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the surface and causes poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep pasture and soil in good condition.

The capability class is I.

407B—Schley loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is on concave to plane slopes around the heads or along the sides of upland drainageways. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is dark grayish brown and brown loam about 11 inches thick. The subsoil is about 42 inches thick. The upper part is grayish brown, friable loam with yellowish brown mottles; the middle part is grayish brown and yellowish brown, friable sandy loam; and the lower part is grayish brown, brown, yellowish brown, and gray, firm loam. In some areas a sandy loam layer below the middle part of the subsoil extends to depths of 50 to 60 inches or more.

Included with this soil in mapping are areas where the surface layer is sandy loam. These areas are generally more seepy and wet than the areas where the surface layer is loam. They are on landscape positions similar to those of this Schley soil and are adjacent to the better drained soils. They make up about 10 percent of the map unit.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction is generally strongly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are cropland. Some are pastureland. This soil is moderately suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Tile drains are needed. Because wetness is partly the result of hillside seepage, a drainage system that intercepts laterally moving water is most successful. Some areas are subject to erosion. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Terracing should be combined with tile drains. Contouring increases wetness unless the soil is properly drained. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. Tile drains are needed for best results, especially on hayland. Overgrazing or grazing when the soil is too wet compacts the surface and causes poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is 1lw.

408B—Olin fine sandy loam, 2 to 5 percent slopes.

This gently sloping, well drained and somewhat excessively drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 20 to 200 acres.

Typically, the surface layer is very dark brown fine sandy loam about 11 inches thick. The subsurface layer is very dark grayish brown and brown fine sandy loam about 13 inches thick. The subsoil is about 29 inches thick. The upper part is dark yellowish brown, very friable sandy loam, and the lower part is dark yellowish brown, firm loam. The substratum is yellowish brown and dark yellowish brown loam.

Permeability is moderately rapid in the upper part of the soil and moderate in the lower part and the substratum. Because of the difference in permeability, water tends to move laterally. In wet seasons seepy areas may develop for short periods. Surface runoff is medium. The available water capacity is moderate. The organic matter content in the plow layer is about 1.0 to 1.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are cropland. A few are pastureland. This soil is moderately suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It may be slightly droughty during extended

dry periods. Erosion by both wind and water is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Erosion control practices, such as contouring or terracing, may be needed. Seepy spots may develop in terrace channels unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is 1le.

408C—Olin fine sandy loam, 5 to 9 percent slopes.

This moderately sloping, well drained and somewhat excessively drained soil is on narrow, convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark brown fine sandy loam about 9 inches thick. The subsurface layer is very dark brown fine sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, very friable sandy loam, and the lower part is dark yellowish brown, firm loam. The substratum is yellowish brown and dark yellowish brown loam.

Permeability is moderately rapid in the upper part of the soil and moderate in the lower part and the substratum. Because of the difference in permeability, water tends to move laterally. In wet seasons seepy areas may develop for short periods. Surface runoff is medium. Available water capacity is moderate. The organic matter content in the plow layer is about 0.5 to 1.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are cropland. A few are pastureland. This soil is moderately suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It may be slightly droughty during extended dry periods. Erosion by both wind and water is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways reduce soil loss. Erosion control practices, such as contouring or terracing, may be needed. Seepy spots may develop in terrace channels unless tile drains are installed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland and pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases

runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep pasture and soil in good condition.

The capability subclass is IIIe.

412C—Sogn loam, 5 to 9 percent slopes. This moderately sloping, somewhat excessively drained soil is on side slopes and ridgetops in uplands. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark gray loam about 4 inches thick. The subsurface layer is very dark brown loam about 11 inches thick. Shattered and fractured limestone is at a depth of 15 inches.

Included with this soil in mapping are areas where the limestone bedrock is exposed. These areas are on the steepest part of the slope. They make up 8 to 12 percent of the map unit.

Permeability is moderate. Surface runoff is medium. The available water capacity is very low. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction is slightly acid or neutral in the surface layer. The soil is generally very low in available phosphorus and available potassium. Tilth is good.

Most areas are permanent pasture or woodland. This soil is poorly suited to cultivated crops and hay and moderately suited to pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain because it is shallow over rock. Erosion is a hazard in cultivated areas. Tillage is difficult because limestone outcrops and limestone fragments occur in the soil.

This soil is moderately suited to pasture. There is little hazard of erosion on pastureland. Overgrazing or grazing when the soil is wet compacts the surface and increases runoff. Pasture rotation and proper stocking are needed to keep the pasture and soil in good condition.

This soil is moderately suited to trees. Planting may be difficult because the soil is shallow over rock.

The capability subclass is VIIc.

412D—Sogn loam, 9 to 18 percent slopes. This strongly sloping and moderately steep, somewhat excessively drained soil is on side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres or more.

Typically, the surface layer is very dark gray loam about 4 inches thick. The subsurface layer is dark brown loam about 8 inches thick. Shattered and fractured limestone bedrock is at a depth of 12 inches.

Included with this soil in mapping are areas where the limestone bedrock is exposed. These areas are on the steepest part of the slope. They make up 10 to 15 percent of the map unit.

Permeability is moderate. Surface runoff is rapid. The available water capacity is very low. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction is slightly acid or neutral in the surface layer. The soil is generally very low in available phosphorus and available potassium. Tilth is good.

Most areas are woodland or wildlife habitat. This soil is poorly suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain and to hay and pasture because of slope and shallowness over limestone bedrock.

This soil is best suited to use as wildlife habitat, but management or seeding may be difficult because of the slope.

The capability subclass is VIIc.

412F—Sogn loam, 18 to 40 percent slopes. This steep and very steep, somewhat excessively drained soil is on side slopes in uplands. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is dark brown loam about 4 inches thick. The subsurface layer is dark brown loam about 4 inches thick. Shattered and fractured limestone bedrock is at a depth of 8 inches.

Included with this soil in mapping are areas where the limestone bedrock is exposed. These areas are on the steepest part of the slope. They make up 10 to 15 percent of the map unit.

Permeability is moderate. Surface runoff is rapid. The available water capacity is very low. The organic matter content in the plow layer is 0.5 to 1.5 percent. Reaction is slightly acid or neutral in the surface layer. The soil is generally very low in available phosphorus and available potassium. Tilth is good.

Nearly all areas are woodland or wildlife habitat. This soil is poorly suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain and to legumes and grasses for hay and pasture because of shallowness over rock and steepness of slopes.

This soil is best suited to use as wildlife habitat, but management or seeding may be difficult because of the slope.

The capability subclass is VIIc.

420—Tama silty clay loam, benches, 0 to 2 percent slopes. This nearly level, well drained soil is on loess covered high stream benches. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 11 inches thick. The subsoil is friable silty clay loam about 35 inches thick. The upper part is dark brown and brown, and the lower part is dark yellowish brown. The substratum is yellowish brown silt loam. Loamy sand or sandy loam with some gravel is typically at a depth of about 5 feet but in places is at 4 feet.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 3.5 to 4.5 percent. Reaction is generally medium acid or slightly acid in the sur-

face layer and the upper part of the subsoil. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is good.

Nearly all areas are cropland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of wind erosion in cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

420B—Tama silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on loess covered high stream benches. Individual areas are generally long and irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 29 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The substratum is yellowish brown silt loam. Coarse textured material is typically at a depth of about 5 feet but may be at 4 feet.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction is generally medium acid or slightly acid in the surface layer and upper part of the subsoil. The subsoil is generally medium in available phosphorus and very low in available potassium. Tilth is good.

Nearly all areas are cropland. This soil is well suited to cultivated crops, hay and pasture, and trees. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In many places the use of contouring and terracing is difficult because of complex contours and short slopes. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on pastureland or hayland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poor tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

426B—Aredale loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on rounded ridgetops and convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 200 acres or more.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 13 inches thick. The subsoil is about 44 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown, very friable sandy loam; and the lower part is dark yellowish brown, firm loam. The substratum is dark yellowish brown loam. In some small areas the surface layer is sandy loam. These areas are slightly droughty and are less productive than this Aredale loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 3.0 to 4.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is generally very low in available phosphorus and available potassium. Tilth is good.

Most areas are cropland. Some are permanent pasture. This soil is well suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places using erosion control practices, such as contouring and terracing, is difficult because of irregular contours. In most places, however, these practices are suitable. Terracing may expose areas of the sandy loam material. These areas are droughty unless recovered with topsoil. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pasture. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep pasture and soil in good condition.

The capability subclass is IIe.

426C—Aredale loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown and dark brown loam about 11 inches thick. The subsoil is about 39 inches thick. The upper part is brown, friable loam; the middle part is dark yellowish brown, very friable sandy loam; and the lower part is dark yellowish brown, firm loam. The substratum is dark yellowish brown loam. In some small areas the

surface layer is sandy loam. These areas are slightly droughty and are less productive than this Aredale loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 2.5 to 3.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is generally very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are cropland. Some are permanent pasture. This soil is moderately suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places, using erosion control practices, such as contouring and terracing, is difficult because of irregular contours. In most places, however, these practices are suitable. Areas of sandy loam may be exposed in terracing. These areas are droughty unless re-covered with topsoil material. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland and pastureland. Overgrazing or grazing when the soil is wet compacts the surface and increases runoff. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

428B—Ely silt loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on alluvial fans or foot slopes at the base of slopes in uplands. Individual areas are irregular in shape and range from 5 to 25 acres.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is silty clay loam about 26 inches thick. The upper part is black; the middle part is very dark gray; and the lower part is very dark grayish brown. The subsoil is dark grayish brown, friable silty clay loam about 24 inches thick. The substratum is yellowish brown sandy loam and dark yellowish brown loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction is generally neutral or slightly acid in the surface layer. The subsurface layer and the subsoil are very low in available phosphorus and available potassium. Tilth is generally good.

Most areas are cropland. Some are pastureland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains, however, may be needed in some

places to remove seepage from the uplands. The soil is also subject to overwash and siltation from upslope. Returning crop residue or adding organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet may compact the surface, increase runoff, and result in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

485—Spillville loam, 0 to 2 percent slopes. This nearly level, moderately well drained and somewhat poorly drained soil is on alluvial flood plains along rivers and major streams. It is subject to occasional flooding. Individual areas are irregular or long and range from 20 to several hundred acres.

Typically, the surface layer is very dark brown loam about 21 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 31 inches thick. The substratum is dark brown fine sand.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 4.5 to 5.5 percent. Reaction is generally slightly acid or medium acid in the surface layer. The subsurface layer is low in available phosphorus and very low in available potassium. Tilth generally is good.

Many areas are cropland. Some are pastureland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. It is, however, subject to flooding. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet may compact the surface and result in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

536—Hanlon fine sandy loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on alluvial flood plains along rivers and major streams. It is subject to occasional flooding. Individual areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is black fine sandy loam about 7 inches thick. The subsurface layer is fine sandy loam about 41 inches thick. It is black in the upper part grading to very dark grayish brown in the lower part. The subsoil is friable sandy loam at least 12 inches thick and is very dark grayish brown with dark brown mottles.

Permeability is moderately rapid. Surface runoff is slow. The available water capacity is moderate. The or-

ganic matter content in the plow layer is about 2.0 to 3.0 percent. Reaction is generally neutral or slightly acid in the surface layer. The subsurface layer and the subsoil are very low in available phosphorus and available potassium. Tilth is good.

Most areas are cropland. Some are pastureland. This soil is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is subject to flooding. Higher areas within the unit are only occasionally flooded. This map unit also includes a few bayous which are wetter than the surrounding area. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. The bayous may be wet enough to interfere with harvesting hay. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

727—Udolpho loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on benches along streams and rivers. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 75 acres.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is dark grayish brown and grayish brown loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is dark grayish brown and grayish brown, friable loam. The lower part is dark grayish brown and grayish brown, very friable loamy sand. The substratum is yellowish brown gravelly sand.

Included with this soil in mapping are areas where sand and gravel are at a depth of as little as 24 inches. These areas may be slightly droughty during dry periods. They are in landscape positions similar to those of this Udolpho soil. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of the soil and rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is 2.0 to 3.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally good unless the soil has been worked when too wet.

Most areas are cropland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. There is some hazard of soil blowing in cultivated areas. Areas that are shallower over sand or

gravel are slightly droughty during extended dry periods. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth. Planting corn or soybeans may be delayed in the spring because of wetness.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

729B—Nodaway-Radford silt loams, 2 to 5 percent slopes. This map unit consists of gently sloping, moderately well drained and somewhat poorly drained, moderately permeable soils in narrow upland drainageways along small streams and waterways. It is subject to frequent flooding. Individual areas range from 20 acres to areas extending across several farms.

This unit is about 60 percent Nodaway soils and 30 percent Radford soils. The Nodaway soil is along the stream or waterway, and the Radford soil is in a band along the edges of the unit. Areas of these soils are so intricately mixed that it is not practical to map them separately.

Typically, the surface layer of the Nodaway soil is very dark grayish brown silt loam about 7 inches thick. The substratum is stratified dark grayish brown and very dark grayish brown silt loam.

Typically, the surface layer of the Radford soil is very dark grayish brown silt loam about 11 inches thick. The subsurface layer is a very dark gray silt loam about 6 inches thick. The substratum is very dark gray silt loam with thin strata of grayish brown. The substratum is underlain by a buried soil that is black silty clay loam.

Permeability is moderate in these soils. Runoff is medium but overwash is received from adjacent soils. The available water capacity is high. The organic matter content in the plow layer is about 2.0 to 3.0 percent. The reaction in the surface layer is generally slightly acid or neutral. The substratum in these soils is medium in available phosphorus and potassium. Tilth is generally good.

Most areas are pastureland. Some are cropland. A few are woodland. Most areas of this unit are in the same use as the surrounding areas because individual areas are generally too narrow to be cropped separately. This unit is moderately suited to cultivated crops and well suited to hay and pasture. It is poorly suited to most engineering uses.

This unit is moderately suited to corn, soybeans, and small grain. Because seepage water from the uplands keeps this unit wet during spring and wet periods, tile drains are generally needed. The unit is subject to overwash and siltation from the soils upslope. It is subject to frequent flooding of short duration. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This unit is well suited to grasses and legumes for hay and pasture. Overwash and siltation from adjacent soils may cause some damage to hay and pasture. Artificial drainage is needed to maintain a good stand for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the soil, increases runoff, and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

771B—Waubee silt loam, 2 to 5 percent slopes.

This gently sloping, moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 52 inches thick. The upper part is brown, friable silty clay loam; the middle part is dark yellowish brown and grayish brown, firm loam; and the lower part is mottled yellowish brown and grayish brown, firm loam. The substratum is yellowish brown loam with grayish brown mottles. In some areas the surface layer is loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 2.0 to 3.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is medium in available phosphorus and very low in available potassium. Tilth is generally fair.

Nearly all areas are cropland. A few are pastureland or woodland. This soil is well suited to cultivated crops and to hay and pasture. It is well suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Erosion, however, is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places the use of erosion control practices, such as contouring or terracing, is difficult because of complex slopes. In most places, however, these practices are suitable. Terracing may expose glacial till, which has lower fertility and poor tilth. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

771C—Waubee silt loam, 5 to 9 percent slopes.

This moderately sloping, moderately well drained soil is

on convex side slopes and ridgetops in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is about 50 inches thick. The upper part is brown, friable silty clay loam; the middle part is dark yellowish brown, firm silty clay loam; and the lower part is mottled yellowish brown and grayish brown, firm loam. The substratum is yellowish brown loam with grayish brown mottles. In some areas the surface layer is loam.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is about 1.5 to 2.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is medium in available phosphorus and very low in available potassium. Tilth is generally fair.

Most areas are pastureland or hayland. This soil is moderately suited to cultivated crops and well suited to hay, pasture, and trees. It is well suited or moderately suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places using erosion control practices, such as contouring or terracing, is difficult because of complex slopes. In most places, however, these practices are suitable. Terracing may expose glacial till, which has lower fertility and poor tilth. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

771C2—Waubee silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in uplands. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is very dark grayish brown silt loam mixed with brown silt loam. It is about 7 inches thick. The subsoil is about 48 inches thick. The upper part is brown, friable silty clay loam; the middle part is dark yellowish brown, friable silty clay loam; and the lower part is yellowish brown and grayish brown, firm loam. The substratum is yellowish brown loam with grayish brown mottles.

Permeability is moderate. Surface runoff is medium. The available water capacity is high. The organic matter

content in the plow layer is about 1.0 to 2.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is medium in available phosphorus and very low in available potassium. Tilth is generally poor.

Most areas are cropland. This soil is moderately suited to cultivated crops and well suited to hay and pasture. It is moderately or well suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Because material from the subsoil, which is very low in available potassium and organic matter, has been mixed into the plow layer, more fertilizer is needed to maintain high yields. Because the organic matter content of the plow layer is lower in this soil than in uneroded adjacent soils, less herbicide is needed. Failure to adjust the rates of herbicides, particularly those that are very sensitive to organic matter levels, may lower yields and in some cases may cause severe loss of plant population. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In places, using erosion control practices, such as contouring or terracing, is difficult because of complex slopes. In most places, however, these practices are suitable. Terracing may expose glacial till, which has lower fertility and even poorer tilth than uneroded Waubeek soils. Returning crop residue or adding other organic material helps to improve fertility and tilth.

This soil is well suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface, increases runoff, and results in poorer tilth. Pasture rotation, proper stocking, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

778—Sattre loam, 0 to 2 percent slopes. This nearly level, well drained soil is on terraces along rivers and major streams. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable loam, and the lower 6 inches is yellowish brown, very friable sand. The substratum is brownish yellow medium sand.

Included with this soil in mapping are areas where the coarse textured material is at a depth of as little as 24 inches. These areas are more droughty than this Sattre soil. They are on landscape positions similar to those of this soil. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of this Sattre soil and very rapid in the lower part. Surface runoff is slow. The available water capacity is moderate. The organic matter content in the plow layer is 1.5 to 2.5

percent. Reaction is generally medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and low in available potassium. Tilth is generally good.

Most areas are cropland. Some are hayland or pasture. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of soil blowing in cultivated areas. Areas that are shallower over sand and gravel are somewhat droughty. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Pasture may be limited, however, during hot dry periods. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

778B—Sattre loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on benches along rivers and streams. Individual areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is dark brown loam about 7 inches thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is about 22 inches thick. It is dark yellowish brown, friable loam grading to sandy loam in the lower part. The substratum is brownish yellow sand.

Included with this soil in mapping are areas where coarse textured material is at a depth as shallow as 24 inches. These areas are more droughty than this Sattre soil. They are located on or near escarpments or short, steep slopes. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of this Sattre soil and very rapid in the lower part. Surface runoff is medium. The available water capacity is moderate. The organic matter content in the plow layer is 1.5 to 2.0 percent. Reaction is generally medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and low in available potassium. Tilth is generally good.

Most areas are cropland. Some are hayland or pastureland. This soil is moderately suited to cultivated crops and to hay and pasture. It is moderately suited to engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. There is some hazard of erosion in cultivated areas. Conservation tillage and winter cover crops reduce soil loss. Erosion control practices, such as contouring, are difficult to use on most areas of this soil because of the irregular contour and short slopes. Terracing may expose areas of the coarse textured substra-

tum. These areas are very droughty unless re-covered with topsoil. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Pasture may be limited during hot, dry periods. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth and increased runoff. Proper stocking, pasture rotation, and deferred grazing during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

782B—Donnan silt loam, 2 to 5 percent slopes.

This gently sloping, somewhat poorly drained and moderately well drained soil is on convex ridgetops or side slopes in uplands. Individual areas are irregular in shape and range from 5 to 20 acres.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The subsoil is more than 51 inches thick. The upper part is dark brown, friable loam; the middle part is yellowish brown, very friable sandy loam; and the lower part is grayish brown very firm silty clay. In some areas the lower subsoil is reddish brown clay loam.

Included with this soil in mapping are areas where the grayish brown silty clay is at a depth of less than 24 inches. These areas are slightly wetter than this Donnan soil. They are on the steepest part of the landscape. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of this Donnan soil and very slow in the lower part. Because of the difference in permeability, water tends to move laterally and often causes seepy spots and wet spots. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 2.0 to 3.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is fair.

Many areas are cropland. Many are pastureland or hayland. This soil is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Practices that improve drainage and those that reduce erosion tend to conflict. Erosion control practices slow down movement of surface water so that more infiltration occurs. Extra water entering the soil complicates drainage, especially in wet years. A combination of terraces and tile drains may be needed. Tile must be placed carefully because permeability is very slow. Tile drains may not be effective in all areas. If the clayey subsoil is deep enough, tile may

be placed above it. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIe.

782C2—Donnan silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained and moderately well drained soil is on convex ridgetops and side slopes in uplands. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is very dark grayish brown silt loam mixed with some brown silt loam. It is about 8 inches thick. The subsoil is at least 52 inches thick. The upper 4 inches is brown and yellowish brown, friable loam; the next 12 inches is yellowish brown, very friable sandy loam; and the lower part is grayish brown, very firm silty clay. In some areas, the lower subsoil is reddish brown clay loam.

Included with this soil in mapping are areas where the grayish brown silty clay is at a depth of less than 24 inches. These areas are slightly wetter than the Donnan loam. They are on the steepest part of the landscape. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the upper part of this Donnan soil and very slow in the lower part. Because of the difference in permeability, water tends to move laterally and commonly causes seepy spots and wet spots. Surface runoff is medium. The available water capacity is high. The organic matter content in the plow layer is 1.5 to 2.0 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is very low in available phosphorus and available potassium. Tilth is generally poor.

Many areas are cropland. Many are pastureland or hayland. This soil is poorly suited to cultivated crops and moderately suited to hay and pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain. Erosion is a hazard in cultivated areas. Conservation tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Practices that provide adequate drainage and those that reduce erosion tend to conflict. Erosion control practices slow movement of surface water so that more infiltration occurs. The extra water entering the soil complicates drainage, especially in wet years. A combination of terraces and tile drains may be needed. Careful placement of tile is needed because of the very slow permeability in the subsoil. Tile drains may not be effective in all areas. If

the clayey subsoil is deep enough, tile may be placed above it. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to grasses and legumes for hay and pasture. There is little hazard of erosion on hayland or pastureland. Overgrazing or grazing when the soil is too wet compacts the surface and increases runoff. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability subclass is IIIe.

1043—Bremer silty clay loam, sandy substratum, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low stream terraces. It formed in alluvium. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 27 inches thick. The upper part is dark gray and very dark gray, and the lower part is light olive gray and olive gray. The substratum is olive gray loamy coarse sand.

Permeability is moderately slow. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 7.0 percent. Reaction is generally neutral or slightly acid in the surface layer and upper part of the subsoil. The subsoil is low in available phosphorus and available potassium. Tilth is generally fair if the soil is not worked when too wet.

Almost all areas are cropland. The soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Artificial drainage is needed. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses for hay and pasture. Overgrazing or grazing when the soil is wet compacts the soil and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is IIw.

1088—Nevin silty clay loam, sandy substratum, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on moderately wide, low alluvial stream benches along rivers and major streams. It is subject to rare flooding. Individual areas are irregular in shape and range from 20 to 100 acres or more.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 27 inches thick. The upper part is dark grayish brown, and

the lower part is grayish brown and dark grayish brown with strong brown mottles. The substratum is dark grayish brown loam with brown and strong brown mottles in the upper part and brown, yellowish brown, and dark yellowish brown loamy sand below that.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction is generally slightly acid or medium acid in the surface layer. The subsoil is medium in available phosphorus and high in available potassium. Tilth is generally good unless the soil has been worked when too wet.

Most areas are cropland. Some are pastureland or hayland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains may be needed to maintain timely field operations. When flood water is very high, this soil is subject to flooding of generally short duration. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the surface and causes poorer tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability class is I.

1119—Muscatine silty clay loam, benches, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess covered high stream benches. Individual areas are irregular in shape and range from 20 to 100 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper and middle parts are dark grayish brown, and the lower part is dark grayish brown mottled with grayish brown and yellowish brown. The substratum is olive gray silt loam with yellowish brown mottles. Loamy sand or sandy loam with some gravel is at a depth of about 5 feet but is at 4 feet in some pedons.

Permeability is moderate. Surface runoff is slow. The available water capacity is very high. The organic matter content in the plow layer is about 5.0 to 6.0 percent. Reaction is generally medium acid or strongly acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and available potassium. Tilth is generally fair or good unless the soil has been worked when too wet.

Nearly all areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately or poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. There is, however, some hazard of soil blowing in

cultivated areas. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth. Tile drains may be needed, and in some areas diversion terraces may be needed to prevent overwash from adjacent higher soils.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

1133—Colo silty clay loam, channeled, 0 to 2 percent slopes. This nearly level, poorly drained soil is on alluvial flood plains dissected by old stream channels, meandering stream channels, and bayous. Most of these channels cannot be crossed with farm machinery. Some are filled with water at least part of the year. This soil is subject to frequent flooding. Individual areas are generally long and range from 10 to 50 acres or more.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 31 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is olive gray friable silty clay loam about 13 inches thick. The substratum is olive gray silty clay loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 5.0 to 7.0 percent. Reaction is generally neutral or slightly acid in the surface layer. The lower part of the surface layer is medium in available phosphorus and very low in available potassium. Tilth is generally fair unless the soil is worked when too wet.

Most areas are pastureland. This soil is poorly suited to cultivated crops and hay and moderately suited to pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, and small grain and to grasses for hay. Many old stream channels, stream meanders, and bayous interfere with cropping. The soil is poorly drained and subject to frequent flooding. Small areas may be cropped if artificially drained.

This soil is moderately suited to grasses for pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is Vw.

1160—Walford silt loam, sandy substratum, 0 to 1 percent slopes. This nearly level, poorly drained or very poorly drained soil is in level or slightly depressed areas on loess covered high stream benches along major streams. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is

grayish brown silt loam about 8 inches thick. The subsoil is about 44 inches thick. The upper few inches is grayish brown silty clay loam; the middle part is gray silty clay loam with yellowish brown mottles; and the lower part is yellowish brown gravelly loamy sand. In places the sand and gravel is at a depth of more than 4 to 5 feet.

Permeability is slow. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction is generally slightly acid or medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally good unless the soil has been worked when too wet.

Almost all areas are cropland. This soil is moderately suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain. It is poorly or very poorly drained and may be ponded at times. Surface drainage and tile drains are needed. Tile drains function slowly because of slow permeability of this soil. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is moderately suited to legumes and grasses for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is llw.

1291—Atterberry silt loam, benches, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on loess covered high stream benches. Individual areas are irregular in shape and range from 10 to 80 acres.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is friable silty clay loam about 34 inches thick. The upper part is brown; the middle part is grayish brown; and the lower part is grayish brown and light olive brown. The substratum is grayish brown silt loam. It is loamy sand or sandy loam with some gravel at a depth of 5 to 6 feet. In some areas this coarse textured material is at a depth of as little as 40 inches.

Permeability is moderate and moderately slow. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is 2.5 to 3.5 percent. Reaction is generally slightly acid. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally fair unless the soil is worked when too wet.

Most areas are cropland. This soil is well suited to cultivated crops and to hay and pasture. It is poorly suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains may be needed for timely field oper-

ations. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and results in poorer tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability class is I.

1485—Spillville loam, channeled, 0 to 2 percent slopes. This nearly level, moderately well drained and somewhat poorly drained soil is on alluvial flood plains dissected by old stream channels, meandering stream channels, and bayous. Most of these channels cannot be crossed with farm machinery. Some contain water at least part of the year. This soil is subject to frequent flooding. Individual areas are generally long and range from 20 to 200 acres.

Typically, the surface layer is very dark brown loam about 21 inches thick. The subsurface layer is about 31 inches thick and is also very dark brown loam. The substratum is dark brown fine sand.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 4.5 to 5.5 percent. Reaction is generally slightly acid or medium acid in the upper part of the surface layer. The upper part of the subsurface layer is low in available phosphorus and very low in available potassium. Tilth is generally good.

Most areas are in pasture. This soil is poorly suited to cultivated crops and to hay and is moderately suited to pasture. It is poorly suited to most engineering uses.

This soil is poorly suited to corn, soybeans, small grain, and hay. Many old stream channels, stream meanders, and bayous interfere with cropping. The soil is also subject to frequent flooding. Small areas may be cropped with adjoining soils.

This soil is moderately suited to grasses and legumes for pasture. Overgrazing or grazing when soil is wet compacts the surface and results in poor tilth. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods are needed to keep the pasture and soil in good condition.

The capability subclass is Vw.

1688—Koszta silt loam, loamy substratum, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on moderately wide, low alluvial stream benches along rivers and major streams. It is subject to rare flooding. Individual areas are irregular in shape and range from 20 to 100 acres or more.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silty clay loam about 38 inches thick. The upper part is dark grayish brown with yellowish brown mottles, and the lower part is grayish brown and olive gray. The substratum is brown and reddish brown sandy loam.

Permeability is moderate. Surface runoff is slow. The available water capacity is high. The organic matter content in the plow layer is about 2.5 to 3.5 percent. Reaction is generally medium acid in the surface layer unless the soil has been limed in the past 5 years. The subsoil is low in available phosphorus and very low in available potassium. Tilth is generally good.

Most areas are cropland. Some are pastureland or hayland. This soil is well suited to cultivated crops and to hay and pasture. It is moderately suited to most engineering uses.

This soil is well suited to corn, soybeans, and small grain. Tile drains may be needed to maintain timely field operations. This soil is subject to flooding during very high water, but flooding is generally of short duration. Returning crop residue or adding other organic material helps to improve fertility and maintain tilth.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet compacts the surface and causes poor tilth. Proper stocking, pasture rotation, and deferred grazing are needed to keep the pasture and soil in good condition.

The capability class is I.

5030—Pits, quarries. These pits are 40 feet deep or more. Piles of spoil 30 feet high or more surround them. The pits are irregular in shape and range from a few acres to as much as 40 acres. Some of the pits with steep side walls contain water a few to many feet deep. The pits are areas where limestone has been quarried for roads and for agricultural lime. Two are areas where gravel has been quarried.

The spoil surrounding the pits is variable in texture. Most, however, is loamy and contains a variable amount of limestone fragments. In some areas the spoil has been leveled and smoothed. In others it is irregular and very uneven. The level areas can be planted to trees or grass. The pH of the spoil is variable but generally ranges from medium acid to mildly alkaline.

These areas are most suitable for wildlife habitat. The pits that contain water will support fish. The steep side walls and the variable depth of the water are hazards that limit use for recreation. Onsite investigation is needed to determine whether an area is safe to use.

5040—Orthents, loamy. This map unit consists of loamy soils in borrow areas and fill areas.

Most borrow areas are along roads and railroads. About 3 to 10 feet of material has been removed for construction purposes. In most areas grass is growing on the sloping banks, but the vertical cuts in some areas are difficult to vegetate.

The soils in the fill areas are variable in texture. Most areas are nearly level and smooth. Some adjoin construction sites. A few are rolling areas of spoil from limestone quarries.

Most soils of this unit have grass on them but are idle. Onsite investigation is needed to determine suitability for any particular use.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The acreage of crops in Benton County was about 288,000 in 1970. The acreage in pasture was about 78,000. Much woodland, which was used for pasture, is

included in this acreage. About 79,000 acres was roads, farmsteads, idle land, unharvested cropland, and other farm uses.

Corn, soybeans, oats, legumes, and legume-grass hay are the main crops. Small acreages of popcorn, sorghum, and wheat are grown in some years. A large acreage of the corn is grown for seed.

Most permanent pastures in Benton County are in bluegrass. Some have been renovated. Other grasses used for pasture are brome grass and orchard grass. Also used are grass-legume mixtures such as alfalfa and brome grass.

Many soils are subject to erosion. The most extensive soils on which erosion control practices are needed are the Aredale, Bassett, Coggon, Dinsdale, Downs, Fayette, Kenyon, Lindley, Olin, and Tama soils. The Tama, Dinsdale, Downs, and Fayette soils commonly have long, uniform slopes and are well suited to erosion control practices. Erosion control structures control gullying in watercourses.

Providing both erosion control and drainage is difficult on the Aredale, Bassett, Coggon, Kenyon, and Olin soils because the permeability of the loamy material in the surface layer differs from that of the material derived from glacial till in the subsoil. Water moves downward more rapidly in the loamy material than in the subsoil. It tends to accumulate at the contact line and then move laterally over the till. Seepy areas develop on side slopes in wet years. Terracing and tiling is most likely to be effective.

Drainage tile reduces wetness in the Colo, Clyde, Floyd, Bremer, Garwin, and Zook soils. It works well in all these soils except Zook soils. In Zook soils, drainage may be slower than in the other soils even if tile are more closely spaced. Surface drainage and protection from runoff also help to reduce wetness in the Colo, Bremer, and Zook soils.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium,

and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 6 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 6 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils and topography of Benton County are suited to many recreation facilities.

Several parks have been developed in the uplands. The largest is Hanon Park, which has facilities for picnicking, camping, fishing, and boating (fig. 12). Hanon Park is in the Fayette-Downs association as are several small parks with various kinds of facilities.



Figure 12.—Many suitable sites for artificial lakes for recreation, such as this lake in Hanon Park, are in the Fayette-Downs association.

Several recreation facilities in the Fluvaquents-Spillville-Flagler association provide public access to the Cedar River for boating as well as areas for hunting and fishing. Areas of the Colo-Ely-Waukegan association along the Iowa River are also suited to recreation facilities. Fishing is an important recreation activity, especially along the Cedar River and in many private ponds throughout the county.

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features,

such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In

planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife habitat

In Benton County the trend to larger farms, larger fields, and more intensive cropping systems has impaired the balance of food, cover, and water that is needed for wildlife. Entire habitats have been destroyed. If this trend continues, the outlook for wildlife is not good.

Any area can be used as wildlife habitat, but areas differ in their degree of suitability for specific habitats and wildlife. For example, the forested Fayette soils provide excellent habitat for such small animals as fox, squirrel, rabbit, ground hog, and birds but do not provide suitable habitat for wetland wildlife such as duck and muskrat.

Topography, fertility, and other soil characteristics influence wildlife. Topography affects wildlife through its influence on land use. Extremely rough, irregular areas such as those of the steep and very steep Sogn, Fayette, and Lindley soils may be hazardous to livestock and unsuited to crops but valuable to wildlife. If suitable vegetation is not native to an area, it can generally be developed to improve habitat for desirable kinds of wildlife.

Soil wetness, permeability, topography, and available water capacity must be considered in selecting areas for constructing ponds for fish and for developing and maintaining habitat for wetland wildlife. The Lindley soils are well suited to ponds for wildlife. The Clyde, Colo, Floyd, and Tripoli soils are moderately suited to wetland wildlife. In areas of Fluvaquents, sandy and loamy, many small undrained depressions support marsh vegetation and hold water part of the year if not all year. Muskrat and mink use these areas. Migrating waterfowl feed and nest there, and mallard, teal, and other ducks nest and raise their young in these areas.

Wooded areas on Fayette, Chelsea, and Lindley soils give protection to fox, squirrel, deer, and many other animals. Cultivated areas of these soils are intermingled with the wooded areas, making food and cover easily accessible to wildlife.

In areas of the other soils, such as Dinsdale, Garwin, Muscatine, and Tama soils, farms are larger and more intensively cropped. Fences have been removed so that large equipment can be used efficiently. The fence rows were valuable as nesting places and travel lanes for wildlife. They also provide a limited food supply. Although the food supply is abundant in the heavily cropped fields, it is not available to wildlife because cover is not available. Year-round cover is needed. Quail, pheasant, and rabbit need cover to escape predators and game and songbirds need cover for nesting places.

The local Soil Conservation Service District Office can provide information and technical assistance in developing and managing wildlife habitat.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various

kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on

soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construc-

tion. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features

are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are gener-

ally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated

good, *fair*, or *poor* as a source of roadfill, topsoil, sand, and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering properties and classifications provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 11 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the

material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 13.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 12 gives information on the soil properties and site features that affect water management. The kinds of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; drainage; irrigation; terraces and diversions; and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering properties and classifications

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (5) and the system adopted by the American Association of State Highway and Transportation Officials (7).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML,

CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of

water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can

occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
- 4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.
4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter

content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is shown for all soils that are underlain by bedrock, at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey

soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (13). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 16, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal

horizonation, plus *aquoll*, the suborder of the Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (12). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (13). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Aredale series

The Aredale series consists of well drained, moderately permeable soils on ridgetops and convex side slopes. These soils formed in loamy material and the underlying loam glacial till. The slope range is 2 to 9 percent.

Aredale soils are commonly adjacent to Dinsdale, Dickinson, and Kenyon soils. They have more sand in the upper part of the solum than the Dinsdale soils but less sand than the Dickinson soils. They have a thicker deposit of loamy material over firm loam glacial till, than do Kenyon soils.

Typical pedon in an area of Aredale loam, 5 to 9 percent slopes, in a cultivated field 1,250 feet north and 594 feet west of the center sec. 33, T. 86 N., R. 12 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam; dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; sand part is dominantly very fine sand; neutral; abrupt smooth boundary.

A12—8 to 14 inches; very dark grayish brown (10YR 3/2) loam; common black (10YR 2/1) coating on peds; grayish brown (10YR 5/2) dry; sand part is dominantly very fine sand; neutral; clear smooth boundary.

A3—14 to 19 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; few very dark brown (10YR 2/2) worm casts; medium acid; clear smooth boundary.

B21—19 to 27 inches; brown (10YR 4/3) light loam; common dark brown (10YR 3/3) coatings on peds; weak fine subangular blocky structure; very friable; medium acid; gradual smooth boundary.

B22—27 to 42 inches; dark yellowish brown (10YR 4/4) light sandy loam; weak medium prismatic structure parting to weak fine and medium subangular blocky; very friable; medium acid; abrupt smooth boundary.

IIB3—42 to 58 inches; dark yellowish brown (10YR 4/4) loam; yellowish brown (10YR 5/6) coatings on peds; weak coarse prismatic structure parting to weak medium subangular blocky; firm; slightly acid; clear smooth boundary.

IIC—58 to 65 inches; dark yellowish brown (10YR 4/4) loam; few distinct strong brown (7.5YR 5/6) mottles; massive; firm; slight effervescence; mildly alkaline.

The solum is commonly 4 feet or more thick. The upper part formed in loamy sediment free of stones and pebbles. Depth to firm loam glacial till ranges from about 40 to 60 inches. In many places, a coarser textured layer as much as 24 inches thick is between the loamy glacial sediment and the glacial till.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2).

The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 through 6. It is free of low chroma mottles to at least 3 feet. It is loam, sandy loam, and loamy sand. Reaction ranges from slightly acid to strongly acid in the B horizon. The IIB3 varies greatly in thickness within short distances. It is typically loam or sandy loam but in places is loamy sand.

Atterberry series

The Atterberry series consists of somewhat poorly drained, moderately permeable and moderately slowly permeable soils on nearly level areas of broad, loess covered uplands or high, loess covered stream benches. The slope range is 0 to 3 percent.

The Atterberry soils in Benton county are grayer in the upper part of the B horizon than is typical for the Atterberry series. This difference does not alter the use or behavior of these soils.

Atterberry soils are similar to Downs and Muscatine soils and are commonly adjacent to Downs and Tama soils. They have a thinner, lighter colored A1 horizon than do Muscatine soils. They have an A2 horizon; the Muscatine soils do not. Atterberry soils have a grayer B horizon and are more poorly drained than Downs soils. They have a thinner A1 horizon and a grayer B horizon and are more poorly drained than Tama soils.

Typical pedon in an area of Atterberry silt loam, 1 to 3 percent slopes, in a cultivated area 795 feet west and 230 feet north of the southeast corner sec. 19, T. 82 N., R. 11 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—9 to 14 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; light brownish gray (10YR 6/2) silt coatings on peds dry; weak medium platy structure parting to moderate fine subangular blocky; friable; slightly acid; clear smooth boundary.

B1—14 to 19 inches; brown (10YR 4/3) light silty clay loam; dark grayish brown (10YR 4/2) coatings on peds; few fine distinct yellowish brown (10YR 5/6) mottles; light brownish gray (10YR 6/2) silt coatings on peds dry; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

B21t—19 to 25 inches; grayish brown (10YR 5/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; light brownish gray (10YR 6/2) silt coatings on peds dry; moderate fine subangular blocky structure; friable; thin discontinuous dark brownish gray (10YR 4/2) clay films on peds; medium acid; clear smooth boundary.

B22t—25 to 34 inches; grayish brown (10YR 5/2) silty clay loam; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine and medium subangular blocky structure; friable; thin nearly continuous dark grayish brown (10YR 4/2) clay films; common fine dark reddish brown (5YR 3/2) oxide concretions; strongly acid; gradual smooth boundary.

B23t—34 to 43 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin discontinuous dark grayish brown (10YR 4/2) clay films; few black

(10YR 2/1) oxide concretions; strongly acid; gradual smooth boundary.

B3t—43 to 48 inches; grayish brown (10YR 5/2) light silty clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; friable; very thin clay films on some prism faces; slightly acid; clear smooth boundary.

C—48 to 60 inches; grayish brown (2.5Y 5/2) heavy silt loam; many fine distinct yellowish brown (10YR 5/6) mottles; massive with some vertical cleavage; friable; common fine black (5YR 2/1) oxide concretions; neutral.

The solum ranges from 40 to 60 inches or more in thickness.

The A1 or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 6 to 10 inches thick. The A2 horizon ranges from 3 to 12 inches in thickness.

The B2 horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 4. Content of clay ranges from about 29 to 34 percent. Reaction is medium acid or strongly acid in the most acid part of the B2t horizon. The B3 horizon generally has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 1 or 2 with higher chroma mottles.

Backbone series

The Backbone series consists of somewhat excessively drained soils that are moderately rapidly permeable in the upper part and moderately slowly permeable in the lower part. These soils are on upland ridges and convex side slopes. They are moderately deep to limestone bedrock. They formed in dominantly wind deposited material and the underlying residuum of limestone. The slope range is 4 to 12 percent.

The Backbone soils in Benton county have a lighter colored surface layer than is typical for the Backbone series. This difference does not alter their use or behavior.

Backbone soils are commonly adjacent to Bassett, Lamont, Sogn, and Whalan soils. They are no more than 40 inches deep over limestone bedrock; Bassett and Lamont soils are much thicker over bedrock. Backbone soils have more sand in the A and B horizons than do Whalan and Sogn soils. They are thicker over limestone bedrock than Sogn soils.

Typical pedon in an area of Backbone fine sandy loam, 4 to 12 percent slopes, in a cultivated field 77 feet south and 1,350 feet east of the center sec. 10, T. 85 N., R. 10 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) and some brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

- A2—9 to 11 inches; dark yellowish brown (10YR 4/4) fine sandy loam; brown (10YR 4/3) coatings on peds; light brownish gray (10YR 6/2) silt coating on peds dry; moderate thin platy structure; very friable; slightly acid; clear smooth boundary.
- B1—11 to 16 inches; dark brown (7.5YR 4/4) fine sandy loam; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
- B21t—16 to 24 inches; dark yellowish brown (10YR 4/4) fine sandy loam; brown (7.5YR 4/4) coatings on peds; moderate fine subangular blocky structure; friable; thin nearly continuous clay films on ped faces and sand grains; slightly acid; gradual smooth boundary.
- B22t—24 to 32 inches; dark yellowish brown (10YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; clay coatings on sand grains; clay content lower than in horizon above; neutral; clear wavy boundary.
- IIB23t—32 to 34 inches; dark yellowish brown (10YR 4/4) silty clay; moderate medium subangular blocky structure; firm; thin nearly continuous clay films on peds; neutral; abrupt wavy boundary.
- R—34 inches; fractured limestone with dark yellowish brown (10YR 4/4) silty clay in the cracks.

Solum thickness and depth to limestone ranges from 20 to 40 inches. Solum thickness and depth to limestone commonly decreases as slope increases.

The Ap or A1 horizon is very dark gray (10YR 3/1), dark brown (10YR 3/3), and brown (10YR 4/3) fine sandy loam 6 to 10 inches thick. Unless this soil is eroded, the A2 horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3), and dark yellowish (10YR 4/4) fine sandy loam about 2 to 6 inches thick.

The B2 horizon has hue of 10YR and chroma and value of 3 or 4; in places the lower part of the B2 horizon has hue of 7.5YR. Reaction ranges from neutral to strongly acid in the B2 horizon.

The IIB2 horizon is silty clay or clay and is 2 to 10 inches thick.

Bassett series

The Bassett series consists of moderately well drained, moderately permeable soils in uplands. These soils formed in 14 to 26 inches of loamy material and the underlying glacial till. The slope range is 2 to 14 percent.

Bassett soils are similar to Kenyon and Coggon soils. They have a thinner A1 horizon than do Kenyon soils and a thicker A1 horizon than do Coggon soils.

Typical pedon in an area of Bassett loam, 2 to 5 percent slopes, in a cultivated field 153 feet north and 2,375 feet east of the center sec. 10, T. 86 N., R. 10 W.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; very strongly acid; abrupt smooth boundary.

- A2—8 to 11 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) coatings on plates and peds; weak thin platy structure parting to moderate fine granular; friable, medium acid; clear smooth boundary.

- B1t—11 to 18 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) coatings on peds; moderate fine subangular blocky structure; friable; light brownish gray (10YR 6/2) sand and silt coatings on peds; thin discontinuous clay films; medium acid; clear smooth boundary.

- IIB21t—18 to 26 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 4/3) coatings on peds; moderate medium subangular blocky structure; firm; thin nearly continuous clay films on ped faces; weak pebble band at 18 inches; some 2 to 6 millimeter pebbles; medium acid; gradual smooth boundary.

- IIB22t—26 to 34 inches; yellowish brown (10YR 5/6) loam; brown (10YR 4/3) coatings on some peds; common medium distinct grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy clay films on peds; some 2 to 6 millimeter pebbles; medium acid; gradual smooth boundary.

- IIB3—34 to 48 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) loam; few medium distinct yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure; firm; very dark grayish brown (10YR 3/2) filling along root channels and coatings on some prism faces; medium acid; clear wavy boundary.

- IIC1—48 to 56 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4 and 5/6) loam; massive; firm; secondary lime concretions; slight effervescence; mildly alkaline; gradual wavy boundary.

- IIC2—56 to 60 inches; yellowish brown (10YR 5/6) loam; common coarse grayish brown (2.5Y 5/2) mottles; massive; firm; slight effervescence; mildly alkaline.

The solum ranges from 36 to 55 inches in thickness.

In undisturbed areas the A1 horizon is very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The A2 horizon ranges from dark brown (10YR 3/3) to brown (10YR 4/3 to 5/3) and is 4 to 6 inches thick. In places it is incorporated wholly in the Ap horizon.

Depth to the IIB horizon ranges from about 14 to 26 inches unless the soil has been eroded. The upper part of the B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or higher. Distinct lower chroma mottles do not occur in the upper part of the B horizon; depth to low chroma mottles ranges from 24 to about 34 inches. The IIB horizon has hue of 10YR, 2.5Y, and 7.5YR, value of 4 or 5, chroma of 3 or higher and lower chroma mottles. The finest texture in the B horizon is typically heavy loam, but in some places it is light clay loam or sandy clay loam. Reaction is strongly acid or very strongly acid in the most acid part of the B horizon.

Bremer series

The Bremer series consists of poorly drained, moderately slowly permeable soils on low stream benches. The slope range is 0 to 2 percent. The Bremer soils in Benton County have a thinner mollic epipedon than is typical for the series and do not have an argillic horizon. These differences do not alter the use or behavior of these soils.

Bremer soils are similar to Nevin and Wiota soils but have a grayer B horizon and are more poorly drained.

Typical pedon in an area of Bremer silty clay loam, sandy substratum, 0 to 2 percent slopes, in a cornfield 790 feet south and 1,860 feet west of the northeast corner sec. 15, T. 86 N., R. 11 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—8 to 13 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; gradual smooth boundary.

A3—13 to 20 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on peds; few fine distinct olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21g—20 to 25 inches; dark gray (5Y 4/1) silty clay loam; very dark gray (10YR 3/1) coatings on some peds; few fine and very fine prominent dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine dark reddish brown (5YR 3/2) oxides; neutral; gradual smooth boundary.

B22g—25 to 34 inches; olive gray (5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine dark brown (7.5YR 3/2) oxides; neutral; gradual smooth boundary.

B3g—34 to 47 inches; light olive gray (5Y 6/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few fine dark brown (7.5YR 3/2) oxides; neutral; abrupt wavy boundary.

IICg—47 to 60 inches; olive gray (5Y 5/2) loamy coarse sand; many fine distinct strong brown (7.5YR 5/6) mottles; single grained; loose; neutral.

The solum ranges from 40 to 60 inches in thickness.

The A1 or Ap horizon is black (10YR 2/1 or N 2/0) or very dark gray (N 3/0). The A horizon is 16 to 23 inches thick.

The B horizon ranges from dark gray (10YR 4/1) to light olive gray (5Y 6/2) with some mottles. It is light to medium silty clay loam 18 inches to 30 inches thick.

The C horizon is gray (5Y 5/1), dark gray (5Y 4/1), or grayish brown (5Y 5/2) sandy loam to loamy coarse sand. In places it is stratified loam, silt loam, and silty clay loam.

Burkhardt series

The Burkhardt series consists of somewhat excessively drained soils that are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. These soils are on high knolls in uplands and on stream escarpments. They formed in 10 to 20 inches of sandy loam and the underlying gravelly loamy sand and sand. The slope range is 2 to 9 percent.

Burkhardt soils are commonly adjacent to Kenyon, Olin, Flagler, Saude, and Waukee soils. Burkhardt soils are shallower to loamy sand or sand than are Flagler, Saude, and Waukee soils. They have a coarser textured substratum than do Kenyon and Olin soils.

Typical pedon in an area of Burkhardt sandy loam, 2 to 9 percent slopes, in a cultivated field 660 feet west and 396 feet north of the southeast corner sec. 16, T. 86 N., R. 9 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) heavy sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; strongly acid; abrupt smooth boundary.

A3—7 to 11 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; weak fine to medium subangular blocky structure; friable; strongly acid; gradual smooth boundary.

B1—11 to 15 inches; dark brown (10YR 3/3) light sandy loam; weak medium subangular blocky structure; friable; strongly acid; gradual smooth boundary.

B2t—15 to 27 inches; brown (7.5YR 4/4) gravelly loamy sand; weak coarse subangular blocky structure; clay bridging between sand grains; very friable; medium acid; gradual smooth boundary.

B3t—27 to 30 inches; strong brown (7.5YR 5/6) gravelly sand; weak coarse subangular blocky structure; very friable; clay bridging between sand grains; medium acid; clear smooth boundary.

C—30 to 60 inches; brown (7.5YR 4/4) and strong brown (7.5YR 5/6) gravelly sand; single grained; loose; medium acid.

Depth to loamy sand or sand ranges from 10 to 20 inches. Thickness of the solum ranges from 20 to 35 inches.

The A horizon ranges from very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) and from 7 to 15 inches in thickness. It is typically sandy loam but includes gravelly sandy loam.

The B2 horizon ranges from light sandy loam to gravelly loamy sand or sand. Reaction in the B horizon ranges from slightly acid to strongly acid.

The C horizon ranges from brown (7.5YR 4/4) to yellowish brown (10YR 5/6). It is loamy sand or sand with some gravel.

Chelsea series

The Chelsea series consists of excessively drained, rapidly permeable soils on upland ridges and side slopes. A few areas are on high benches along the major rivers. These soils formed in dominantly wind deposited sand. On benches coarse sand and gravel may occur below 4 feet. The slope range is 1 to 30 percent.

Chelsea soils are similar to Sparta, Lamont, and Dickinson soils. They have a higher sand content in the upper 3 feet than do Lamont soils. They have a thinner and generally lighter colored A1 horizon than Sparta soils. They have more sand in the upper solum and a thinner and generally lighter colored A1 horizon than do Dickinson soils. They also have an A2 horizon; the Dickinson soils do not.

Typical pedon in an area of Chelsea loamy fine sand, 5 to 9 percent slopes, in a pasture 1,625 feet east and 805 feet south of northwest corner sec. 16, T. 85 N., R. 9 W.

- Ap—0 to 4 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.
- A21—4 to 7 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.
- A22—7 to 13 inches; dark yellowish brown (10YR 4/4) fine sand; single grained; loose; medium acid; gradual smooth boundary.
- A23—13 to 41 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; medium acid; clear smooth boundary.
- A&B—41 to 60 inches; yellowish brown (10YR 5/4) fine sand A2 part; single grained; loose; 1/2 inch to 2 inches thick bands of brown (7.5YR 4/4) loamy sand at 42 to 59 inches B2t part; medium acid.

The solum ranges from 4 to many feet in thickness.

The A1 or Ap horizon has color of 10YR 3/2 to 10YR 4/3. It is loamy fine sand or sand 2 to 6 inches thick. The A2 horizon has color of 10YR 4/3 and 10YR 4/4 in the upper part and 10YR 4/4 to 10YR 6/4 in the lower part. It is loamy fine sand or fine sand. Reaction ranges from slightly acid to strongly acid in the A2 horizon. The B part of the A&B horizon is thin bands of loamy sand or sandy loam. It has hue of 7.5YR or 10YR and value and chroma of 3 or 4. Depth to the uppermost lamella ranges from 27 to 48 inches.

Clyde series

The Clyde series consists of poorly drained, moderately permeable soils in nearly level drainageways and lower concave positions in uplands. These soils formed in 24 to 50 inches of loamy and sandy sediment and in

the underlying loam glacial till. The slope range is 0 to 4 percent.

Clyde soils are similar to Floyd soils. They have a grayer B horizon and are more poorly drained than Floyd soils.

Typical pedon in an area of Clyde silty clay loam, 0 to 2 percent slopes, in a cultivated field 2,360 feet west and 132 feet south of the northeast corner sec. 29, T. 86 N., R. 9 W.

- Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, high in sand, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few 2 to 3 millimeter pebbles; neutral; abrupt smooth boundary.
- A12—9 to 17 inches; black (10YR 2/1) silty clay loam, high in sand, dark gray (10YR 4/1) dry; moderate fine and medium subangular blocky structure; friable; few 2 to 3 millimeter pebbles; neutral; gradual smooth boundary.
- A3—17 to 23 inches; very dark gray (5Y 3/1) silty clay loam, high in sand; very dark grayish brown (10YR 3/2) coatings on peds; few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few 2 to 3 millimeter pebbles; neutral; clear smooth boundary.
- B21—23 to 28 inches; mottled dark grayish brown (2.5Y 4/2) and olive gray (5Y 4/2) gritty light silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; very friable; moderate fine and medium subangular blocky structure; few 2 to 3 millimeter pebbles; neutral; clear smooth boundary.
- B22g—28 to 32 inches; dark gray (5Y 4/1) loam; common medium prominent yellowish brown (10YR 5/6) and brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; very friable; few 2 to 3 millimeter pebbles; neutral; clear smooth boundary.
- B23g—32 to 36 inches; olive gray (5Y 5/2) sandy loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few 2 to 3 millimeter pebbles; neutral; clear smooth boundary.
- B24g—36 to 41 inches; olive gray (5Y 5/2) loamy sand; common medium prominent mottles; weak medium and coarse subangular blocky structure; very friable; neutral; abrupt smooth boundary.
- II B3—41 to 45 inches; mottled gray (5Y 6/1) and yellowish brown (10YR 5/8) loam; weak coarse prismatic structure parting to moderate medium subangular blocky, firm; few fine distinct black (5YR 2/1) oxide concretions; few 2 to 3 millimeter pebbles; neutral; clear smooth boundary.
- II C—45 to 65 inches; mottled gray (5Y 6/1) and yellowish brown (10YR 5/8) loam; massive; some 2 to 3 millimeter pebbles; strong effervescence; moderately alkaline.

Solum thickness is typically more than 3 1/2 feet and ranges from 2 1/2 to 5 feet or more. Depth to glacial till is typically 3 to 4 feet but ranges from 2 1/2 to 5 feet.

The A horizon ranges from about 20 to 24 inches in thickness. It ranges from gritty silty clay loam or clay loam to loam.

The B horizon is commonly clay loam or loam, but soils having some strata of silty clay loam and layers of sandy loam or loamy sand typically less than 6 inches thick are within the range of the series.

Coggon series

The Coggon series consists of moderately well drained, moderately permeable soils in uplands. These soils formed in 12 to 22 inches of loamy material and in the underlying glacial till. The slope range is 2 to 9 percent.

Coggon soils are similar to Kenyon and Bassett soils but have a thinner or lighter colored A1 horizon.

Typical pedon in an area of Coggon loam, 2 to 5 percent slopes, in a wooded pasture, 1,000 feet south and 265 feet west of the northeast corner sec. 9, T. 85 N., R. 9 W.

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; neutral; clear wavy boundary.

A2—4 to 9 inches; brown (10YR 4/3) loam, very pale brown (10YR 7/3) dry; weak thin platy structure parting to weak fine subangular blocky; friable; slightly acid; clear smooth boundary.

B1—9 to 15 inches; yellowish brown (10YR 5/4) heavy loam; moderate fine subangular blocky structure; friable; many stones and pebbles in the lower part; very strongly acid; clear wavy boundary.

IIB21t—15 to 23 inches; strong brown (7.5YR 5/6) light clay loam with yellowish brown (10YR 5/4) coatings on peds; moderate medium subangular blocky structure; firm; thin discontinuous clay films; common black (10YR 2/1) oxide concretions in lower part; very strongly acid; gradual smooth boundary.

IIB22t—23 to 34 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; strong brown (7.5YR 5/6) coatings on peds; few fine distinct dark red (2.5YR 3/6) mottles and few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular and angular blocky structure; firm; thin discontinuous clay films; very strongly acid; gradual smooth boundary.

IIB23t—34 to 40 inches; yellowish brown (10YR 5/4 and 5/6) light clay loam; few fine distinct gray (5Y 5/1) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few thin discontinuous clay films; very strongly acid; gradual smooth boundary.

IIB3—40 to 56 inches; yellowish brown (10YR 5/6) light clay loam; moderate medium prismatic structure

parting to strong medium subangular blocky; firm; few olive gray (5Y 2/2) oxide concretions; slightly acid; gradual smooth boundary.

IIC—56 to 60 inches; yellowish brown (10YR 5/6) heavy loam; many fine distinct gray (5Y 5/1) and olive gray (5Y 5/2) mottles; massive; firm; strong effervescence; mildly alkaline.

Solum thickness is typically about 60 inches and ranges from 50 to 70 inches.

The A1 horizon is 2 to 5 inches thick and is commonly very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). If an Ap horizon occurs, it is typically dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 4/3 or 5/3). In eroded areas, most of the A2 horizon is mixed with the Ap horizon. The A horizon is typically loam.

The B horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) in the upper part. It is yellowish brown (10YR 5/4 to 5/6) or strong brown (7.5YR 5/6 to 5/8) in the lower part. Below about 30 inches, mottles of 2 chroma or lower increase in size and number as depth increases. The IIB2 horizon is commonly heavy loam but ranges to loam, clay loam, or sandy clay loam. Reaction is strongly or very strongly acid in the IIB2 horizon.

Colo series

The Colo series consists of poorly drained, moderately permeable soils formed in alluvium on level flood plains and along narrow drains in uplands. The slope range is 0 to 2 percent.

Colo soils are commonly adjacent to Spillville soils. They have a higher clay content and a grayer C horizon than do Spillville soils.

Typical pedon in an area of Colo silty clay loam, 0 to 2 percent slopes, in a cultivated field 2,490 feet south and 140 feet west of the northeast corner sec. 16, T. 86 N., R. 11 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—7 to 22 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; friable; neutral; gradual smooth boundary.

A13—22 to 32 inches; black (10YR 2/1) silty clay loam; very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A14—32 to 38 inches; very dark gray (10YR 3/1) silty clay loam; few olive gray (5Y 5/2) mottles at 36 to 38 inches; moderate fine subangular blocky structure; friable; few dark brown (7.5YR 4/4) oxides; neutral; clear smooth boundary.

- B2—38 to 51 inches; olive gray (5Y 4/2) silty clay loam; few fine yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak medium subangular blocky; friable; few dark brown (7.5YR 4/4) oxides; a very dark gray (10YR 3/1) krotovina 1 to 2 inches in diameter; neutral; clear smooth boundary.
- C—51 to 60 inches; olive gray (5Y 5/2) silty clay loam; fine common distinct yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure; friable; neutral.

The solum ranges from 36 to about 60 inches in thickness. The A horizon has hue of 2.5Y or 10YR, value of 2 or 3 to depths of 36 inches or more, and chroma of 0 or 1. It is typically silty clay loam, but the upper 10 inches ranges to heavy silt loam. Below 10 inches, the clay content is 30 to 35 percent and is as high as 38 percent in thin layers.

The B and C horizons have hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 or 2. Few to common high chroma mottles occur in some places. Soils with sandy or gravelly horizons below 4 feet are within the range of the series. Reaction is slightly acid to neutral throughout the solum.

Dickinson series

The Dickinson series consists of well drained and somewhat excessively drained soils that are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. They are on upland ridges and high stream benches. They formed in dominantly wind deposited sand. On benches coarse sand and gravel may occur below 4 feet. The slope range is 0 to 9 percent.

Dickinson soils are similar to Lamont and Sparta soils. They have less sand in the A and B horizons than do Sparta soils. They have a thicker and generally darker A1 horizon than do Lamont soils.

Typical pedon in an area of Dickinson fine sandy loam, 2 to 5 percent slopes, in a pasture 1,320 feet east and 792 feet north of the center sec. 29, T. 86 N., R. 9 W.

- Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
- A12—7 to 16 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; very friable; slightly acid; gradual smooth boundary.
- B1—16 to 20 inches; dark yellowish brown (10YR 3/4) fine sandy loam; dark brown (10YR 3/3) coatings on peds; moderate fine and medium subangular blocky structure; very friable; slightly acid; gradual smooth boundary.
- B2—20 to 26 inches; brown (10YR 4/3) fine sandy loam; dark brown (10YR 3/3) coatings on peds; moderate

medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

- B3—26 to 31 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.
- C1—31 to 46 inches; yellowish brown (10YR 5/4) sand; single grained; loose; slightly acid; clear smooth boundary.
- C2—46 to 60 inches; brown (7.5YR 4/4) loamy sand; single grained; loose; slightly acid.

The solum ranges from 24 to 40 inches in thickness. Depth to loamy sand and sand is commonly 24 to 36 inches. Sand particles are dominantly fine and medium in size.

The A horizon ranges from black (10YR 2/1) or very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2). It is commonly 10 to 20 inches thick.

The B2 horizon is dark brown (10YR 3/3) or brown (10YR 4/3) in the upper part and dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4 and 5/6) in the lower part. Reaction ranges from slightly to medium acid in the B horizon.

The C horizon ranges from loamy sand to fine sand or sand.

Dinsdale series

The Dinsdale series consists of moderately well drained, moderately permeable soils on convex ridgetops and side slopes in uplands. These soils formed in 24 to 40 inches of loess and the underlying glacial till. The slope range is 2 to 9 percent.

Dinsdale soils are similar to Klinger, Maxfield, and Waubeek soils. They are commonly adjacent to Tama and Kenyon soils. They have a thicker A horizon than do Waubeek soils. They contain more sand in the lower part of the B horizon than do Tama soils. They have a browner B horizon and are better drained than Klinger and Maxfield soils. They are lower in sand content in the upper part of the profile and are deeper to firm loam glacial till than are Kenyon soils.

Typical pedon in an area of Dinsdale silty clay loam, 2 to 5 percent slopes, in a cultivated field 2,166 feet west and 165 feet north of the center sec. 27, T. 84 N., R. 12 W.

- Ap—0 to 7 inches; very dark brown (10YR 2/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; friable; neutral; clear smooth boundary.
- A12—7 to 14 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
- B1—14 to 20 inches; brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) coatings on

pedes; moderate fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—20 to 26 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) coatings on pedes; moderate fine and very fine subangular blocky structure; friable; thin discontinuous clay films on pedes; slightly acid; clear smooth boundary.

B22t—26 to 38 inches; brown (10YR 4/3) silty clay loam; weak medium prismatic structure parting to moderate very fine and fine subangular blocky; friable; thin discontinuous clay films; medium acid; clear smooth boundary.

IIB3t—38 to 47 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) heavy loam; moderate medium prismatic structure; firm; thin discontinuous clay films on prism faces; few fine dark oxide concretions; few pebbles; slightly acid; gradual smooth boundary.

IIC—47 to 60 inches; yellowish brown (10YR 5/4 and 5/6) heavy loam; few faint strong brown (7.5YR 5/6) mottles; massive; firm; few dark oxide concretions; few pebbles; slightly acid.

The solum is typically about 50 inches thick but ranges from about 40 to 60 inches. Dinsdale soils formed in loess and glacial till. The loess is typically 24 to 40 inches thick and ranges from about 20 to 42 inches.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), and very dark grayish brown (10YR 3/2). Thickness ranges from 10 to 20 inches unless the soil is eroded. The upper part of the B horizon, which formed in loess, is dark brown (10YR 3/3), brown (10YR 4/3), and dark yellowish brown (10YR 4/4). The clay content ranges from about 29 to 34 percent. Reaction ranges from slightly acid to strongly acid in the upper part of the B horizon.

The lower part of the B horizon and the C horizon formed in glacial till. These horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. These horizons contain few to common mottles that have value of 4 to 6 and chroma of 1 or 2. They are typically loam. In places, a layer of sandy loam or loamy sand as much as 10 inches thick is between the loess and the glacial till. Carbonates are at a depth of about 45 to 65 inches.

The Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded, map unit has Dinsdale soils with a mollic epipedon that is not as thick as the defined range of the Dinsdale series. This difference does not alter the use or behavior of this map unit.

Donnan series

The Donnan series consists of somewhat poorly drained and moderately well drained soils that are moderately permeable in the upper part and very slowly permeable in the lower part. They are in uplands. They formed in 24 to 40 inches of loamy material and in the underlying highly weathered paleosol. The slope range is 2 to 9 percent.

The Donnan soils are commonly adjacent to Bassett, Dinsdale, and Kenyon soils. They contain more clay in the lower part of the B horizon than do those soils.

Typical pedon in an area of Donnan silt loam, 5 to 9 percent slopes, moderately eroded, in a cultivated field 190 feet west and 70 feet south of the northeast corner sec. 8, T. 86 N., R. 9 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) with some mixing of brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; few fine faint brown (7.5YR 4/4) mottles; moderate very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—12 to 21 inches; yellowish brown (10YR 5/4) light loam; dark yellowish brown (10YR 4/4) coatings on pedes; moderate very fine subangular blocky structure; very thin patchy clay films on pedes; friable; slightly acid; clear smooth boundary.

B22t—21 to 25 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; clay coatings on sand grains and some clay bridging between sand grains; very friable; slightly acid; abrupt smooth boundary.

IIB23t—25 to 33 inches; grayish brown (2.5Y 5/2) silty clay; few fine distinct yellowish red (5YR 5/6) mottles; strong very fine subangular blocky structure; thin continuous clay films on pedes; very firm; strongly acid; gradual smooth boundary.

IIB24t—33 to 60 inches; grayish brown (2.5Y 5/2) silty clay; few fine faint olive brown (2.5Y 5/4) mottles; strong very fine subangular blocky structure; thin continuous clay films on pedes; very firm; medium acid.

The solum ranges from 50 inches to more than 80 inches in thickness. All of the solum is friable because the part of the soil that developed from loamy material merges with a buried paleosol. The loamy overburden ranges from 20 to 40 inches thick over the buried soil.

The A1 or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 6 to 8 inches thick. In some areas the soil has an A2 horizon. It is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) and is 2 to 5 inches thick. In places it is wholly incorporated in the Ap horizon. The A horizon ranges from loam or gritty silt loam to light clay loam or gritty silty clay loam.

The upper part of the B horizon has hue of 10YR or 2.5Y, value of 4 and 5, and chroma of 3 or 4 and may be mottled. It is clay loam, loam, or sandy loam but ranges to gritty silty clay loam. Reaction ranges from slightly acid to strongly acid in the B2 horizon.

The IIB horizon developed in a clay or silty clay paleosol. It has hue of 5Y or 2.5Y, value of 5 and 6, and

chroma of 1 or 2. Higher chroma mottles are common in places.

Downs series

The Downs series consists of well drained, moderately permeable soils on loess covered upland ridges and side slopes. These soils formed in loess that is more than 48 inches deep. Most of the Downs soils are along the major rivers. The slope range is 2 to 14 percent.

Downs soils are similar to Fayette and Tama soils. They have an A1 horizon that is thicker or darker colored than that of Fayette soils but thinner and lighter colored than that of Tama soils.

Typical pedon in an area of Downs silt loam, 2 to 5 percent slopes, in a pasture 145 feet south and 65 feet east of the northwest corner of sec. 29, T. 82 N., R. 11 W.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.
- A2—7 to 10 inches; brown (10YR 4/3) silt loam; dark grayish brown (10YR 4/2) coatings on some peds; moderate fine subangular blocky structure; friable; pale brown (10YR 6/3) silt coatings on peds dry; very dark grayish brown (10YR 3/2) fill in root channels; slightly acid; clear smooth boundary.
- B1—10 to 16 inches; brown (10YR 4/3) light silty clay loam; dark brown (10YR 3/3) coatings on peds; moderate fine and very fine subangular blocky and angular blocky structure; friable; pale brown (10YR 6/3) silt coatings on peds dry; slightly acid; clear smooth boundary.
- B21t—16 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on peds; moderate fine subangular and angular blocky structure; friable; thin patchy clay films; slightly acid; clear smooth boundary.
- B22t—22 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on peds; moderate fine subangular blocky and angular blocky structure; friable; thin patchy clay films; few small dark oxide concretions; medium acid; clear smooth boundary.
- B23t—27 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam; dark brown (10YR 4/3) coatings on peds; moderate fine subangular blocky structure; friable; thin patchy clay films; common small dark oxide concretions; medium acid; clear smooth boundary.
- B31t—31 to 42 inches; brown (10YR 5/3) light silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; thin patchy clay films; few fine dark reddish brown (5YR 2/2) oxide concretions; strongly acid; gradual smooth boundary.

- B32—42 to 52 inches; mottled brown (10YR 5/3) and yellowish brown (10YR 5/4) heavy silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; common fine dark reddish brown (5YR 3/2) oxide concretions; medium acid; gradual smooth boundary.
- C—52 to 60 inches; mottled brown (10YR 5/3) and yellowish brown (10YR 5/4) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; common fine dark reddish brown (5YR 3/2) oxide concretions; medium acid.

The solum ranges from 42 to 70 inches in thickness.

The A1 horizon is very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) and is 6 to 10 inches thick. The A2 horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3) and is 2 to 4 inches thick. In some areas the A2 horizon is incorporated wholly in the Ap horizon.

The upper part of the B horizon is commonly brown (10YR 4/3) to dark yellowish brown (10YR 4/4), grading to value of 4 or 5 and chroma of 3 to 6 with increasing depth. The finest textured part of the B horizon is light to medium silty clay loam. The clay content ranges from 30 to 35 percent. Depth to low chroma mottles is typically more than 30 inches. Reaction ranges from slightly acid to strongly acid in the B horizon.

Ely series

The Ely series consists of somewhat poorly drained, moderately permeable soils formed in medium textured alluvium on foot slopes and on alluvial fans at the base of slopes in uplands. The slope range is 2 to 5 percent.

Ely soils are similar to Colo soils. They have a browner B horizon and are better drained than Colo soils.

Typical pedon in an area of Ely silt loam, 2 to 5 percent slopes in a cultivated field 1,310 feet north and 740 feet west of the southeast corner sec. 17, T. 86 N., R. 11 W.

- Ap—0 to 8 inches; black (10YR 2/1) silt loam; very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.
- A12—8 to 16 inches; black (10YR 2/1) light silty clay loam; dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.
- A13—16 to 24 inches; very dark gray (10YR 3/1) silty clay loam; dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on peds; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
- A3—24 to 34 inches; very dark grayish brown (10YR 3/2) silty clay loam; very dark gray (10YR 3/1) coatings on peds; few fine faint dark grayish brown (2.5Y 4/2) mottles; few fine distinct dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B2—34 to 42 inches; dark grayish brown (10YR 4/2) light silty clay loam; dark gray (10YR 4/1) coatings on peds; few fine distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; neutral; clear smooth boundary.

B3—42 to 58 inches; dark grayish brown (2.5Y 4/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; friable; few fine dark reddish brown (5YR 2/2) oxides; neutral; clear smooth boundary.

C1—58 to 62 inches; yellowish brown (10YR 5/4) sandy loam; single grained; loose; few 5 to 10 millimeter pebbles; neutral; clear smooth boundary.

IIC2—62 to 65 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct olive gray (5Y 5/2) mottles; firm; mildly alkaline.

The solum is usually more than 48 inches thick and ranges from 40 to more than 70 inches.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It has colors with value of 3 to a depth of 24 to 36 inches. It is silt loam or silty clay loam.

The matrix of the B2 horizon is typically dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2), but in the lower part it may be higher in chroma and have low chroma mottles. The B horizon is silty clay loam that contains about 30 to 35 percent clay. Reaction typically ranges from slightly acid to medium acid in the most acid part of the soil but may be neutral throughout.

Fayette series

The Fayette series consists of well drained, moderately permeable soils on loess covered upland ridges and side slopes. These soils formed in loess more than 48 inches deep. Most Fayette soils are along the major rivers and on pahas. The slope range is 2 to 40 percent.

Fayette soils are similar to Downs and Tama soils. They have a thinner A1 horizon and a thicker A2 horizon than Downs soils have. They have a thinner A1 horizon than do Tama soils. They also have an A2 horizon; Tama soils do not.

Typical pedon in an area of Fayette silt loam, 2 to 5 percent slopes, in wooded area 2,100 feet north and 20 feet east of the southwest corner sec. 23, T. 85 N., R. 9 W.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A2—5 to 10 inches; brown (10YR 4/3) silt loam; light gray (10YR 7/2) dry; dark grayish brown (10YR 4/2) coatings on peds; moderate medium platy structure

parting to weak very fine subangular blocky; friable; slightly acid; clear wavy boundary.

B1—10 to 14 inches; brown (10YR 4/3) heavy silt loam; moderate very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

B21t—14 to 18 inches; dark yellowish brown (10YR 4/4) light silty clay loam; yellowish brown (10YR 5/4) coatings on peds; moderate fine and medium angular blocky and subangular blocky structure; friable; thin nearly continuous clay films on ped surfaces and in most channels; strongly acid; clear smooth boundary.

B22t—18 to 24 inches; brown (10YR 4/3) silty clay loam; brown (10YR 5/3) coatings on peds; very pale brown (10YR 7/3) silt and sand coatings on peds dry; strong fine and medium angular blocky structure; friable; thin nearly continuous clay films on peds; strongly acid; gradual smooth boundary.

B23t—24 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; very pale brown (10YR 7/3) silt and sand coatings on peds dry; strong medium angular blocky structure; firm; thin nearly continuous clay films on ped surfaces; few dark reddish brown (5YR 2/2) stains on peds; strongly acid; gradual smooth boundary.

B3t—35 to 46 inches; yellowish brown (10YR 5/4) light silty clay loam; few fine faint brown (10YR 5/3) mottles and few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; friable; thin patchy clay films on prism surfaces; few dark reddish brown (5YR 2/2) stains on peds; few dark reddish brown (5YR 2/2) oxide concretions; strongly acid; gradual smooth boundary.

C—46 to 60 inches; yellowish brown (10YR 5/4) silt loam; few fine faint brown (10YR 5/3) mottles and few fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; strongly acid.

The solum ranges from 36 to 55 inches in thickness.

The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and ranges in thickness from 2 to 5 inches. In cultivated areas the Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 4/3 or 5/3). The A2 horizon is typically dark grayish brown (10YR 4/2) but ranges to grayish brown (10YR 5/2) and brown (10YR 4/3). It is 4 to 8 inches thick. In eroded areas all the A2 horizon may be incorporated into the Ap horizon.

The B2t horizon ranges in value from 4 to 5 and in chroma from 3 through 6. It is typically light to medium silty clay loam that is 28 to 34 percent clay. In some places the lower part of the B horizon and the C horizon have mottles of 10YR or 2.5Y hue, 5 value, and 1 or 2 chroma. On convex slopes, depth to these grayish mottles typically decreases with increasing gradient. Reaction ranges from strongly acid to very strongly acid in the B horizon.

Finchford series

The Finchford series consists of excessively drained, very rapidly permeable soils formed in coarse textured alluvium on level high flood plains along the major rivers. The slope range is 0 to 2 percent.

Finchford soils are commonly adjacent to Hanlon and Spillville soils. They have less clay and more medium and coarse sand in the solum than do those soils.

Typical pedon in an area of Finchford loamy sand, 0 to 2 percent slopes, in a cultivated field, 925 feet south and 65 feet east of the northwest corner sec. 8, T. 85 N., R. 10 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy sand; dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; few 2 to 3 millimeter pebbles; slightly acid; clear smooth boundary.

A12—8 to 19 inches; very dark grayish brown (10YR 3/2) loamy sand; grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; slightly acid; gradual smooth boundary.

B—19 to 37 inches; dark brown (10YR 3/3) sand; weak coarse subangular blocky structure; loose; slightly acid; gradual smooth boundary.

C—37 to 60 inches; very dark grayish brown (10YR 3/2) loamy sand; few fine faint dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) mottles; weak coarse subangular blocky structure; very friable; medium acid.

The solum ranges from 20 to 40 inches in thickness.

The A horizon has hue of 7.5YR or 10YR, value of 2 through 4, and chroma of 2 through 4. It is sand or loamy sand that is generally more than 30 percent medium and coarse sand.

The B horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. It is loamy sand or sand.

The C horizon has hue of 7.5YR or 10YR, value of 3 through 6, and chroma of 2 or 3.

Flagler series

The Flagler series consists of somewhat excessively drained soils that are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They are on stream benches along major streams and rivers. These soils formed in 10 to 36 inches of sandy loam and in the underlying sand and gravel. The slope range is 0 to 5 percent.

Flagler soils are commonly adjacent to Saude, Waukee, and Lawler soils. They have more sand and are coarser in texture in the upper horizons than those soils. They have a browner B horizon and are better drained than Lawler soils.

Typical pedon in an area of Flagler sandy loam, 0 to 2 percent slopes, in pasture 1,810 feet north and 50 feet east of the center sec. 17, T. 85 N., R. 10 W.

Ap—0 to 8 inches; black (10YR 2/1) heavy sandy loam; dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; few pebbles more than 2 millimeters; neutral; clear smooth boundary.

A12—8 to 18 inches; very dark brown (10YR 2/2) heavy sandy loam; dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; few pebbles more than 2 millimeters; neutral; clear smooth boundary.

A3—18 to 23 inches; very dark grayish brown (10YR 3/2) heavy sandy loam; weak fine subangular blocky structure; very friable; few pebbles more than 2 millimeters; slightly acid; clear smooth boundary.

B2—23 to 29 inches; dark yellowish brown (10YR 3/4) light sandy loam; weak medium and fine subangular blocky structure; very friable; few pebbles more than 2 millimeters; medium acid; abrupt smooth boundary.

IIB3—29 to 36 inches; brown (7.5YR 4/4) gravelly sand; single grained; loose; slightly acid; gradual smooth boundary.

IIC1—36 to 49 inches; brown (10YR 4/3) sand; single grained; loose; few pebbles more than 2 millimeters; slightly acid; gradual smooth boundary.

IIC2—49 to 65 inches; brown (10YR 5/3) sand; single grained; loose; many pebbles more than 2 millimeters; slightly acid.

Solum thickness typically ranges from 30 to 40 inches. Depth to loamy sand, gravelly sand, or sand ranges from 24 to 30 inches.

The A1 or Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The A horizon ranges from about 12 to 24 inches in thickness.

The B2 horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 through 6. It ranges from 10 to 18 percent clay and is typically 60 to 70 percent sand. Reaction ranges from slightly to strongly acid in the B horizon.

The IIC horizon has hue of (10YR or 7.5YR), value of 4 or 5, and chroma of 3 through 8. It is typically sand, coarse sand, gravelly sand, or gravelly loamy sand.

Floyd series

The Floyd series consists of somewhat poorly drained, moderately permeable soils in uplands. These soils formed in 30 to 45 inches of loamy and sandy sediment and in the underlying loam glacial till. The slope range is 1 to 4 percent.

Floyd soils are commonly adjacent to Schley, Readlyn, and Clyde soils. They have a thicker and generally darker colored A1 horizon than do Schley soils. They are more stratified, deeper to the firm loam glacial till, and less acid than Readlyn soils. They are neither as gray in the B horizon nor so poorly drained as Clyde soils.

Typical pedon in an area of Floyd loam, 1 to 4 percent slopes, in a pasture 250 feet east and 1,450 feet north of the center sec. 29, T. 86 N., R. 9 W.

- Ap—0 to 8 inches; black (10YR 2/1) loam; dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.
- A12—8 to 19 inches; black (10YR 2/1) loam; dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
- A3—19 to 23 inches; very dark grayish brown (10YR 3/2) loam; few fine faint yellowish brown (10YR 5/4 and 10YR 5/6) mottles; very dark gray (10YR 3/1) coatings on peds; moderate fine and medium subangular blocky structure; friable; neutral; clear smooth boundary.
- B1—23 to 29 inches; dark grayish brown (10YR 4/2) loam; common fine distinct yellowish brown (10YR 5/4 and 10YR 5/6) mottles; very dark grayish brown (10YR 3/2) on some surfaces of peds; moderate fine and medium subangular blocky structure; friable; neutral; clear smooth boundary.
- B21—29 to 34 inches; grayish brown (10YR 5/2) light sandy clay loam; many fine distinct yellowish brown (10YR 5/6 and 10YR 5/8) mottles; moderate medium subangular blocky structure; friable; pebble band at 34 inches; neutral; clear smooth boundary.
- B22—34 to 43 inches; grayish brown (10YR 5/2) sandy loam; many medium yellowish brown (10YR 5/6 and 10YR 5/8) mottles; weak medium subangular blocky structure; friable; few pebbles more than 2 millimeters; neutral; clear smooth boundary.
- IIB3—43 to 61 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) heavy loam; grayish brown (2.5Y 5/2) coatings on peds; weak coarse prismatic structure parting to moderate coarse subangular blocky; firm; neutral; clear wavy boundary.
- IIC—61 to 76 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) heavy loam; massive; firm; slight effervescence; mildly alkaline.

The solum thickness ranges from about 40 to 72 inches. Thickness of the loamy overburden over loam glacial till ranges from 30 to 45 inches.

The A1 horizon is typically black (10YR 2/1) but ranges from black (N 2/0) to very dark gray (10YR 3/1). The A3 horizon ranges from very dark gray (10YR 3/1) to very dark grayish brown (2.5Y 3/2). The A horizon is typically loam but ranges to gritty silt loam, light clay loam, and gritty light silty clay loam.

The B horizon has hue of 2.5Y and 10YR, value of 4 to 5, and chroma of 2 to 6. Texture of the B horizon includes loam, gritty silty clay loam, sandy clay loam, light clay loam, and thin horizons of sandy loam with a weighted clay content of more than 18 percent. Depth to carbonates ranges from 50 to 80 inches. Reaction in the B horizon ranges from neutral to slightly acid.

Garwin series

The Garwin series consists of poorly drained, moderately permeable soils formed in loess on uplands. The slope range is 0 to 2 percent.

Garwin soils are similar to Maxfield, Muscatine, and Tama soils. They do not have firm, loam in the lower part of the solum as do Maxfield soils. They have a grayer B horizon and are more poorly drained than Tama and Muscatine soils.

Typical pedon in an area of Garwin silty clay loam, 0 to 2 percent slopes, in a cultivated field 70 feet east and 1,850 feet north of the southwest corner sec. 16, T. 85 N., R. 12 W.

- Ap—0 to 7 inches; black (10YR 2/1) light silty clay loam; dark gray (10YR 4/1) dry; moderate subangular blocky structure; friable; neutral; abrupt smooth boundary.
- A12—7 to 16 inches; black (N 2/0) silty clay loam; dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
- A3—16 to 22 inches; very dark gray (10YR 3/1) silty clay loam; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
- B21g—22 to 31 inches; olive gray (5Y 5/2) silty clay loam; dark gray (10YR 4/1) coatings on peds; few fine faint olive (5Y 4/3) mottles and few fine faint olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.
- B22g—31 to 39 inches; olive gray (5Y 5/2) light silty clay loam; few fine faint olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; few fine black (10YR 2/1) oxide concretions; neutral; clear smooth boundary.
- B3g—39 to 48 inches; olive gray (5Y 5/2) light silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few fine black (10YR 2/1) oxide concretions; neutral; gradual smooth boundary.
- C1g—48 to 60 inches; light brownish gray (2.5Y 6/2) heavy silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few fine black (10YR 2/1) oxides; neutral; gradual smooth boundary.
- C2g—60 to 70 inches; mottled light olive brown (2.5Y 5/4) and light olive gray (5Y 6/2) heavy silt loam; massive; friable; neutral.

The solum ranges from 36 to 50 inches in thickness.

The A1 or Ap horizon ranges from black (N 2/0) to very dark gray (10YR 3/1). The A horizon ranges from 14 to 23 inches in thickness and from silty clay loam to heavy silt loam in texture.

The B2 horizon has hue of 5Y and 2.5Y, value of 3 to 5, and chroma of 1 or 2. The B1 or B2 horizon ranges from 30 to 36 percent clay. Depth to carbonates is 48 to 70 inches or more. Reaction is slightly acid to neutral in the B horizon.

Hanlon series

The Hanlon series consists of moderately well drained, moderately rapidly permeable soils formed in medium textured alluvium along major streams and rivers. The slope range is 0 to 2 percent.

Hanlon soils are commonly adjacent to Spillville soils. Hanlon soils have more sand in the solum than do Spillville soils.

Typical pedon in an area of Hanlon fine sandy loam, 0 to 2 percent slopes, in a cultivated field 285 feet east and 2,625 feet north of the southwest corner sec. 10, T. 86 N., R. 12 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam; dark gray (10YR 4/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—7 to 27 inches; black (10YR 2/1) fine sandy loam; dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

A13—27 to 42 inches; very dark brown (10YR 2/2) fine sandy loam; dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

A14—42 to 48 inches; very dark grayish brown (10YR 3/2) sandy loam; few fine faint dark brown (7.5YR 3/2) mottles; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

B2—48 to 60 inches; very dark grayish brown (10YR 3/2) sandy loam; common fine faint dark brown (7.5YR 3/2) mottles; weak coarse prismatic structure; neutral.

The solum ranges from 46 to 65 inches in thickness.

The A horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), black (10YR 2/1), or very dark gray (10YR 3/1). It is fine sandy loam and sandy loam 40 to 60 inches thick.

The B horizon is very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) sandy loam.

Kenyon series

The Kenyon series consists of moderately well drained, moderately permeable soils in uplands. These soils formed in 14 to 24 inches of loamy material and in the underlying glacial till. The slope range is 2 to 14 percent.

Kenyon soils are similar to Bassett and Readlyn soils and are commonly adjacent to Floyd and Clyde soils. They have a thicker A1 horizon than Bassett soils. They have a browner B horizon and are better drained than Readlyn, Floyd, and Clyde soils.

Typical pedon in an area of Kenyon loam, 2 to 5 percent slopes, in a hayfield 1,000 feet west and 450 feet north of the southeast corner sec. 1, T. 85 N., R. 10 W.

A11—0 to 11 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—11 to 15 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; moderate fine subangular blocky structure; friable; medium acid; clear smooth boundary.

A3—15 to 18 inches; dark brown (10YR 3/3) loam; very dark grayish brown (10YR 3/2) and a few very dark brown (10YR 2/2) coatings on peds; moderate fine and medium subangular blocky structure; friable; medium acid; clear smooth boundary.

IIB1—18 to 25 inches; brown (10YR 4/3) loam; with very dark grayish brown (10YR 3/2) coatings on peds; moderate fine and medium subangular blocky structure; friable; pebble band at 22 inches; medium acid; clear smooth boundary.

IIB21—25 to 32 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 4/3) coatings on peds; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.

IIB22—32 to 39 inches; yellowish brown (10YR 5/6) loam; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; medium acid; clear smooth boundary.

IIB31—39 to 48 inches; yellowish brown (10YR 5/4) loam; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; slightly acid; clear smooth boundary.

IIB32—48 to 54 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; firm, neutral; clear smooth boundary.

IIC—54 to 60 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; firm; slight effervescence; mildly alkaline.

The solum thickness ranges from 45 to 60 inches.

The A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It ranges from about 10 to 20 inches in thickness, unless the soil is eroded, and generally decreases as gradient increases. The A horizon is typically loam but includes silt loam high in content of sand.

The B2 horizon has hue of 10YR, value of dominantly 3 to 5, and chroma of 3 to 6.

Depth to the IIB horizon is 14 to 24 inches unless the soil has been eroded. Reaction ranges from medium acid to strongly acid in the B2 horizon.

The IIB horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 8 with mottles. It is typically heavy loam but includes light clay loam and sandy clay loam.

The IIC horizon is similar in color and texture to the IIB horizon except that grayish mottles are more common.

In Benton County, Kenyon loam, 5 to 9 percent slopes, moderately eroded, and Kenyon loam, 9 to 14 percent slopes, moderately eroded, have a mollic epipedon that is not as thick as the defined range of the Kenyon soils. This difference does not alter the use or behavior of the soils.

Klinger series

The Klinger series consists of somewhat poorly drained, moderately permeable soils in loess covered uplands. These soils formed in loess 24 to 40 inches thick and in the underlying glacial till. The slope range is 1 to 4 percent.

Klinger soils are commonly adjacent to Dinsdale and Muscatine soils. They have a grayer B horizon and are more poorly drained than Dinsdale soils. They have a higher sand content in the lower part of the B horizon than do Muscatine soils.

Typical pedon in an area of Klinger silty clay loam, 1 to 4 percent slopes, in a hayfield 1,210 feet west and 595 feet south of the center sec. 31, T. 86 N., R. 11 W.

Ap—0 to 8 inches; black (10YR 2/1) light silty clay loam; dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—8 to 14 inches; very dark brown (10YR 2/2) silty clay loam; dark grayish brown (10YR 4/2) dry; black (10YR 2/1) coatings on peds; moderate fine granular structure; friable; medium acid; clear smooth boundary.

A3—14 to 17 inches; dark brown (10YR 3/3) silty clay loam; very dark brown (10YR 2/2) coatings on peds; moderate fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B21t—17 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine and medium subangular blocky structure; friable; medium acid; gradual smooth boundary.

B22t—24 to 39 inches; dark grayish brown (10YR 4/2) silty clay loam; few strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few thin discontinuous clay films on peds; a few clay lined pores; few fine dark reddish brown (5YR 2/2) oxides; slightly acid; abrupt smooth boundary.

11B3—39 to 48 inches; yellowish brown (10YR 5/8) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; weak coarse prismatic structure; firm; slightly acid; clear wavy boundary.

11C—48 to 60 inches; yellowish brown (10YR 5/8) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; massive; firm; slight effervescence; mildly alkaline.

The solum ranges from about 40 to 60 inches in thickness.

The A horizon is typically black (10YR 2/1) or very dark brown (10YR 2/2) grading to value of 3 and chroma

of 1 to 3 in the lower part. It ranges in thickness from 16 to 22 inches.

The B2 horizon, formed in loess, is dominantly dark grayish brown (10YR 4/2) but includes value of 5 and chroma of 3 or 4 in a minor part of the matrix. The B2t horizon ranges from 28 to 35 percent clay. Reaction in the B horizon ranges from slightly acid to medium acid.

Depth to the 11Bt horizon is 24 to 40 inches. The 11Bt horizon varies in hue and has value of 4 or 5 and chroma of 2 to 8. Texture is loam, light clay loam, or sandy clay loam.

Koszta series

The Koszta series consists of somewhat poorly drained, moderately permeable soils on nearly level low stream benches. These soils formed in silty alluvium. The slope range is 0 to 2 percent. The Koszta soils in Benton County are grayer in the upper part of the B horizon than is typical for the Koszta series. This difference does not alter use or behavior of the soils.

Koszta soils are similar to Wiota and Nevin soils. They have a grayer B horizon and are more poorly drained than Wiota soils. They have a thinner, lighter colored A1 horizon than do Nevin soils.

Typical pedon in an area of Koszta silt loam, loamy substratum, 0 to 2 percent slopes, in a cultivated field 1,300 feet south and 567 feet east of the northwest corner sec. 21, T. 82 N., R. 9 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) heavy silt loam; grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; neutral; abrupt smooth boundary.

A2—7 to 13 inches; dark grayish brown (10YR 4/2) heavy silt loam; light brownish gray (10YR 6/2) dry; very dark gray (10YR 3/1) coatings on some plates; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium platy structure parting to moderate very fine subangular blocky; friable; strongly acid; clear smooth boundary.

B1—13 to 19 inches; dark grayish brown (10YR 4/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; strongly acid; moderate very fine subangular blocky structure; friable; gradual smooth boundary.

B21t—19 to 23 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate very fine subangular blocky structure; friable; very thin patchy clay films on peds; strongly acid; gradual smooth boundary.

B22t—23 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine subangular blocky structure; friable; thin nearly continuous clay films on peds; few soft black oxides; strongly acid; gradual smooth boundary.

B23t—30 to 45 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; friable; thin nearly continuous clay films on prisms and peds; medium acid; gradual smooth boundary.

B3—45 to 51 inches; olive gray (5Y 5/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; medium acid; abrupt smooth boundary.

C—51 to 60 inches; mottled brown (10YR 4/3) and reddish brown (5YR 5/6) sandy loam; massive; loose; slightly acid.

The solum ranges from 40 to 60 inches in thickness.

The A1 horizon is silt loam. It ranges from 6 to 10 inches in thickness and from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color. The A2 horizon is silt loam. It is very dark gray (10YR 3/1) to grayish brown (10YR 5/2) and is 3 to 6 inches thick.

The B horizon is dark grayish brown (10YR 4/2) mottled with grayish brown (2.5Y 5/2), gray (5Y 5/1), light gray (5Y 6/1), olive gray (5Y 5/2), and yellowish brown (10YR 5/4, 5/6, and 5/8). Reaction ranges from medium to strongly acid.

The C horizon ranges from sandy loam to loamy sand but includes stratified loam and silt loam.

Lamont series

The Lamont series consists of well drained soils that are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They are on upland ridges and side slopes and on high stream benches. They formed in dominantly wind deposited sand. On benches coarse sand and gravel may occur below 4 feet. The slope range is 2 to 30 percent.

Lamont soils are similar to Chelsea and Dickinson soils. They have a thinner and generally a lighter colored A1 horizon than do Dickinson soils. They are not as coarse textured as are Chelsea soils.

Typical pedon in an area of Lamont fine sandy loam, 2 to 5 percent slopes, in a pasture 1,625 feet north and 200 feet east of the southwest corner sec. 36, T. 85 N., R. 9 W.

A1—0 to 4 inches; very dark gray (10YR 3/1) fine sandy loam; grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; medium acid; clear smooth boundary.

A2—4 to 10 inches; brown (10YR 4/3) light fine sandy loam; pale brown (10YR 6/3) dry; weak coarse platy structure; very friable; common very dark gray (10YR 3/1) worm casts; medium acid; clear smooth boundary.

B21t—10 to 15 inches; dark yellowish brown (10YR 4/4) sandy loam; very fine and fine subangular blocky structure; friable; few very dark gray (10YR 3/1)

worm casts; some clay bridging between sand grains; medium acid; gradual smooth boundary.

B22t—15 to 21 inches; dark brown (7.5YR 4/4) heavy sandy loam; moderate fine and medium subangular blocky structure; friable; some clay bridging between sand grains; medium acid; clear smooth boundary.

B23t—21 to 25 inches; yellowish brown (10YR 5/4) light sandy loam; weak medium subangular blocky structure; very friable; some clay bridging between sand grains; strongly acid; clear smooth boundary.

B31—25 to 33 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; strongly acid; clear smooth boundary.

B32—33 to 40 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; strongly acid; clear smooth boundary.

C—40 to 60 inches; yellowish brown (10YR 5/4) loamy sand; single grained; loose; dark yellowish brown (10YR 4/4); clay band at 52 to 54 inches; strongly acid.

The solum ranges from 24 to 60 inches in thickness.

The A1 horizon is dark grayish brown (10YR 4/2), dark gray (10YR 4/1), or very dark gray (10YR 3/1). Unless eroded, the A2 horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2) and brown (10YR 4/3). In some places the A2 horizon may be wholly incorporated in the Ap horizon.

The B2 horizon ranges from sandy loam to light loam and light sandy clay loam. It has hue of 10YR to 7.5YR, value of 4 or 5, and chroma of 3 to 6. Reaction ranges from medium acid to very strongly acid.

Lawler series

The Lawler series consists of somewhat poorly drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. They are on benches along river and streams. These soils formed in 32 to 40 inches of loamy material and in the underlying coarse textured material. The slope range is 0 to 2 percent.

Lawler soils are commonly adjacent to Udolpho, Saude, and Waukee soils. They are also similar to those soils but have a thicker A1 horizon than do Udolpho soils and are more poorly drained and have a grayer B horizon than the Saude and Waukee soils.

Typical pedon in an area of Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes, in a cultivated field 1,800 feet west and 325 feet south of northeast corner sec. 36, T. 86 N., R. 10 W.

Ap—0 to 8 inches; black (10YR 2/1) loam; dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—8 to 15 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; moderate fine suban-

gular blocky structure; friable; medium acid; clear smooth boundary.

- A3—15 to 21 inches; very dark grayish brown (10YR 3/2) loam; very dark gray (10YR 3/1) coatings on peds; weak medium subangular blocky structure; friable; medium acid; clear smooth boundary.
- B2—21 to 30 inches; dark grayish brown (10YR 4/2) heavy loam; common fine distinct yellowish brown (10YR 5/6) mottles; few thin discontinuous light brownish gray (10YR 6/2) silt coatings on peds dry; weak medium subangular blocky structure; friable; medium acid; clear smooth boundary.
- B31—30 to 34 inches; dark grayish brown (10YR 4/2) sandy loam; many fine distinct yellowish brown (10YR 5/6) mottles; few thin discontinuous light brownish gray (10YR 6/2) silt coatings on peds; weak coarse subangular blocky structure; friable; medium acid; abrupt smooth boundary.
- IIB32—34 to 38 inches; dark yellowish brown (10YR 4/4) gravelly sand; weak coarse prismatic structure; very friable; many 3 to 8 centimeter pebbles; medium acid; gradual smooth boundary.
- IIC1—38 to 60 inches; yellowish brown (10YR 5/4) sand; single grained; loose; many 3 to 8 centimeter pebbles; slightly acid; gradual smooth boundary.
- IIC2—60 to 65 inches; brown (10YR 4/3) gravelly sand; single grained; loose; many 3 to 8 centimeter pebbles; slightly acid.

Depth to coarse textured material ranges from 32 to 40 inches, and generally corresponds to solum thickness.

The A horizon is loam or silt loam high in content of sand. The A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). The A3 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Total thickness of the A horizon typically ranges from 12 to 18 inches, but in some areas ranges to 24 inches.

The B2 horizon is typically dark grayish brown (2.5Y or 10YR 4/2) with high chroma mottles. It is typically heavy loam but ranges from loam to light sandy clay loam. Reaction is slightly acid or medium acid in the B horizon.

In areas where depth to sand and gravel is near the minimum described for the series, the soil has a IIB3 horizon that formed in coarse material. The IIB3 horizon or the upper part of the C horizon typically ranges from loamy coarse sand to loamy medium gravel.

Lindley series

The Lindley series consists of well drained, moderately slowly permeable soils on convex lower side slopes of uplands. These soils formed in glacial till. The slope range is 14 to 25 percent.

Lindley soils are commonly adjacent to Fayette soils. They contain more sand throughout the solum than do Fayette soils.

Typical pedon in an area of Lindley loam, 18 to 25 percent slopes, in a pasture 1,920 feet south and 200

feet west of the northeast corner sec. 34, T. 82 N., R. 11 W.

- Ap—0 to 5 inches; dark brown (10YR 3/3) and brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate very fine granular structure; friable; medium acid; abrupt smooth boundary.
- A2—5 to 7 inches; mixed brown (10YR 4/3) and brown (10YR 5/3) loam, yellowish brown (10YR 5/4) dry; some dark brown (10YR 3/3) coatings on peds; weak thin platy structure; friable; very strongly acid; abrupt smooth boundary.
- B1—7 to 11 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; firm; strongly acid; clear smooth boundary.
- B21t—11 to 16 inches; yellowish brown (10YR 5/4) light clay loam; moderate fine subangular blocky structure; firm; thin nearly continuous clay films; strongly acid; gradual smooth boundary.
- B22t—16 to 26 inches; yellowish brown (10YR 5/6) light clay loam; light brownish gray (10YR 6/2) silt coatings on many peds dry; strong fine and medium subangular blocky and angular blocky structure; firm; thin nearly continuous clay films on peds; strongly acid; diffuse wavy boundary.
- B23t—26 to 39 inches; mottled yellowish brown (10YR 5/6 and 5/8) light clay loam; strong fine and medium subangular blocky and angular blocky structure; firm; thin nearly level continuous clay films on peds; strongly acid; clear smooth boundary.
- B3t—39 to 49 inches; yellowish brown (10YR 5/4 and 5/6) light clay loam; few fine prominent olive (5Y 5/4) mottles; weak medium prismatic structure; firm; common fine dark reddish brown (5YR 2/2) oxide concretions; thin patchy clay films on prisms; neutral; abrupt smooth boundary.
- C—49 to 60 inches; yellowish brown (10YR 5/4 and 5/6) light clay loam; few fine faint yellowish brown (10YR 5/8) mottles; many fine prominent olive (5Y 5/4) mottles; massive; firm; many black oxides; slight effervescence; mildly alkaline.

Solum thickness ranges from 35 to 60 inches.

The A1 horizon ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2) and brown (10YR 4/3). It is typically loam but is silt loam in places and includes clay loam in eroded areas. The A1 horizon is 1 to 5 inches thick. The A2 horizon has hue of 10YR, value of 4 through 6, and chroma of 2 or 4. It is loam and is 2 to 7 inches thick.

The Bt horizon is dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/6) clay loam and is 20 to 40 inches thick.

The C horizon is yellowish brown (10YR 5/4) or (10YR 5/6) and has light gray to strong brown and olive mottles.

Maxfield series

The Maxfield series consists of poorly drained, moderately permeable soils on broad, nearly level ridgetops in uplands. These soils formed in a mantle of loess and in the underlying firm loam glacial till. The slope range is 0 to 2 percent.

Maxfield soils are similar to Dinsdale, Klinger and Waubeek soils. They have a grayer B horizon and are more poorly drained than those soils.

Typical pedon in an area of Maxfield silty clay loam, 0 to 2 percent slopes, in a cultivated field 55 feet west and 105 feet south of the northeast corner sec. 31, T. 86 N., R. 9 W.

- Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.
- A12—8 to 16 inches; black (N 2/0) silty clay loam; very dark gray (N 3/0) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.
- A3—16 to 21 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; few fine faint olive gray (5Y 4/2) mottles; moderate fine and medium subangular blocky structure; friable; neutral; clear smooth boundary.
- B1g—21 to 24 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; very dark gray (10YR 3/1) coatings on peds; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.
- B21g—24 to 27 inches; mottled dark gray (5Y 4/1) and olive gray (5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; some very dark gray (10YR 3/1) coatings on some peds; moderate fine subangular blocky structure; friable; neutral; clear wavy boundary.
- B22g—27 to 33 inches; olive gray (5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; dark gray (10YR 4/1) coatings on some peds; moderate fine and medium subangular blocky structure; friable; neutral; abrupt smooth boundary.
- B23—33 to 37 inches; mottled light olive gray (5Y 6/2) and yellowish brown (10YR 5/4) sandy loam; common medium faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.
- IIB31—37 to 41 inches; mottled gray (5Y 5/1) and yellowish brown (10YR 5/6) loam; light olive gray (5Y 6/2) on faces of prisms; few coarse distinct strong brown (7.5YR 5/8) mottles; weak medium prismatic structure; firm; neutral; abrupt smooth boundary.
- IIB32—41 to 50 inches; mottled gray (5Y 5/1) and yellowish brown (10YR 5/8) loam; light gray (5Y 6/1) on faces of prisms; weak medium prismatic structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

IIC—50 to 65 inches; mottled gray (5Y 5/1) and yellowish brown (10YR 5/8) loam; massive; firm; slight effervescence; mildly alkaline.

Solum thickness is typically about 48 inches and ranges from about 40 to 55 inches. The loess mantle is typically 24 to 40 inches thick but ranges from 20 to 42 inches.

The A horizon is black (N 2/0 or 10YR 2/1) and very dark gray (10YR or 5Y 3/1).

The upper part of the B horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It ranges from heavy silt loam to silty clay loam.

The IIB3 horizon has hue of 7.5YR to 5Y, value of 4 or 5, and chroma of 3 through 8 with lower chroma mottles. It is typically loam and ranges to light clay loam and sandy clay loam. A layer of loamy sand or sand typically less than 10 inches thick commonly separates the loess and the underlying glacial till. The IIC horizon has the same color and texture as the IIB3. Carbonates are at a depth of about 40 to 60 inches. Reaction is typically neutral but ranges to slightly acid in the most acid part of the solum.

Muscatine series

The Muscatine series consists of somewhat poorly drained, moderately permeable soils on loess covered upland divides and loess covered stream benches. The slope range is 0 to 5 percent.

Muscatine soils are similar to Garwin, Tama, and Atterberry soils. They have a thicker A1 horizon than do Atterberry soils and do not have an A2 horizon. They have a browner B horizon and are better drained than the Garwin soils. They have a grayer B horizon and are more poorly drained than the Tama soils.

Typical pedon in an area of Muscatine silty clay loam, 0 to 2 percent slopes, in a cultivated field 2,060 feet east and 267 feet north of the southwest corner sec. 8, T. 85 N., R. 12 W.

- Ap—0 to 8 inches; black (10YR 2/1) light silty clay loam; moderate fine granular structure; friable; medium acid; abrupt smooth boundary.
- A12—8 to 12 inches; very dark brown (10YR 2/2) light silty clay loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on peds; moderate fine granular structure; friable; medium acid; clear smooth boundary.
- A13—12 to 17 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; black (10YR 2/1) coatings on peds; moderate fine subangular blocky structure; friable; strongly acid; clear smooth boundary.
- A3—17 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam; very dark gray (10YR 3/1) coatings on peds; moderate fine subangular blocky structure; friable; medium acid; clear smooth boundary.

- B21t—20 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on peds; moderate fine subangular blocky structure; friable; thin discontinuous clay films on peds and in root channels; medium acid; gradual smooth boundary.
- B22t—24 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) coatings on peds; few fine faint grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; friable; thin nearly continuous clay films; medium acid; gradual smooth boundary.
- B23t—30 to 38 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure; friable; thin discontinuous clay films; very dark grayish brown (10YR 3/2) stains along root channels; slightly acid; clear boundary.
- B3—38 to 46 inches; dark grayish brown (2.5Y 4/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure; friable; few dark reddish brown (5YR 2/2) oxides; neutral; gradual boundary.
- C—46 to 60 inches; olive gray (5Y 5/2) heavy silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive with some vertical cleavage; friable; few dark reddish brown (5YR 2/2) oxides; neutral.

Solum thickness ranges from 50 to 70 inches.

The A horizon ranges from black (10YR 2/1) and very dark gray (10YR 3/1) to very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2). It is 14 to 20 inches thick.

The B horizon has hue of 10YR and 2.5Y, value of 4 or 5, and chroma of 2 with higher chroma mottles. The B2 horizon is about 27 to 35 percent clay. Reaction in the B2 horizon is slightly acid to strongly acid.

Nevin series

The Nevin series consists of somewhat poorly drained, moderately permeable soils on nearly level, low stream benches. These soils formed in silty alluvium. The slope range is 0 to 2 percent. The Nevin soils in Benton County have a thinner mollic epipedon than is defined for the Nevin series and do not have an argillic horizon. These differences do not alter the use or behavior of the soils.

Nevin soils are similar to Wiota and Bremer soils. Nevin soils have a grayer B horizon and are more poorly drained than Wiota soils. They have a browner B horizon and are better drained than Bremer soils.

Typical pedon in an area of Nevin silty clay loam, sandy substratum, 0 to 2 percent slopes, in a cultivated field 650 feet south and 45 feet west of the northeast corner sec. 20, T. 82 N., R. 9 W.

Ap—0 to 7 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; moderate very fine granular blocky structure; friable; neutral clear smooth boundary.

A12—7 to 11 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A13—11 to 17 inches; very dark grayish brown (10YR 3/2) light silty clay loam; very dark gray (10YR 3/1) coatings on peds; moderate very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1—17 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) coatings on some ped surfaces; few fine faint yellowish brown (10YR 5/4) mottles; moderate very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B21t—22 to 27 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on some peds; few fine faint yellowish brown (10YR 5/4) mottles; moderate very fine subangular blocky structure; friable; thin patchy clay films on peds; medium acid; clear smooth boundary.

B22t—27 to 32 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coatings on a few peds; common fine faint yellowish brown (10YR 5/6) mottles; moderate very fine subangular blocky structure; friable; thin nearly continuous clay films on peds; medium acid; clear smooth boundary.

B23t—32 to 38 inches; grayish brown (10YR 5/2) silty clay loam; common fine and medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate fine subangular blocky; friable; very thin patchy clay films on prisms and peds; few black (5YR 2/1) oxides; medium acid; clear smooth boundary.

B3—38 to 44 inches; dark grayish brown (2.5Y 4/2) medium silty clay loam; common fine and medium distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure; friable; few black (5YR 2/1) oxides; medium acid; abrupt smooth boundary.

C1—44 to 55 inches; dark grayish brown (2.5Y 4/2) loam high in fine sand; common fine and medium distinct brown (7.5YR 5/4) and strong brown (7.5YR 5/6) mottles; massive; friable; medium acid; abrupt smooth boundary.

C2—55 to 60 inches; mottled dark yellowish brown (10YR 4/4), brown (10YR 5/3), and yellowish brown (10YR 5/4) loamy sand; single grained; loose; medium acid.

Solum thickness is typically more than 40 inches and ranges from 36 to 60 inches or more.

The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It ranges from 18 to 24

inches in thickness to 30 inches in a few places. It is typically light silty clay loam but ranges to silt loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3 with high chroma mottles. It ranges from about 30 percent to about 35 percent clay. Reaction ranges from slightly acid to medium acid.

The C horizon ranges from sandy loam to loamy sand or sand but includes stratified loam and silt loam in some places.

Nodaway series

The Nodaway series consists of moderately well drained, moderately permeable soils formed in recently deposited silty alluvium along rivers, major streams, and narrow upland drainageways. The slope range is 0 to 5 percent.

Nodaway soils are similar to Colo and Spillville soils. They are lighter colored and more stratified, lower in clay content, and better drained than Colo soils. They have more silt and less sand than do Spillville soils.

Typical pedon in an area of Nodaway silt loam, 0 to 2 percent slopes, in a pasture 2,420 feet east and 265 feet north of the southwest corner sec. 32, T. 82 N., R. 11 W.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very thin platy structure caused by stratification; very friable; slightly acid; clear smooth boundary.

C1—7 to 10 inches; dark grayish brown (10YR 4/2) silt loam; weak very thin platy structure caused by stratification; very friable; slightly acid; clear smooth boundary.

C2—10 to 16 inches; very dark grayish brown (10YR 3/2) silt loam; weak very thin platy structure caused by stratification; very friable; slightly acid; clear smooth boundary.

C3—16 to 60 inches; stratified dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam; weak very thin platy structure caused by stratification; common fine distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles or stains along root channels or buried plant material; very friable; neutral.

The A1 horizon ranges from very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2). It is 6 to 10 inches thick and generally shows some evidence of stratification. In cultivated areas, the Ap horizon is very dark grayish brown (10YR 3/2).

The C horizon dominantly has hue of 10YR, value of 3, 4, or 5, and chroma of 2 and 3. Some strata have chroma of 1. Dark, medium or moderately fine textured buried soils are below 40 inches in some areas. Texture is typically silt loam, but in some layers is light silty clay loam. Only thin lenses of material coarser than silt loam are at a depth of less than 40 inches. Sandy material is below 40 inches in some places. Reaction ranges from slightly acid to neutral.

Olin series

The Olin series consists of well drained and somewhat excessively drained soils that are moderately rapidly permeable in the upper part and moderately permeable in the lower part. They are on convex upland ridges and side slopes. These soils formed in 20 to 36 inches of sandy loam and in the underlying glacial till. The slope range is 2 to 9 percent.

Olin soils are commonly adjacent to Kenyon, Dickinson, and Sparta soils. They are shallower over firm loam than the Dickinson soils. They have more sand in the upper part of the solum than do Kenyon soils. They contain less sand than do Sparta soils.

Typical pedon in an area of Olin fine sandy loam, 2 to 5 percent slopes, in a pasture 240 feet south and 2,120 feet west of the northeast corner sec. 29, T. 86 N., R. 9 W.

A11—0 to 11 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; very friable; slightly acid; gradual smooth boundary.

A12—11 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

A3—20 to 24 inches; brown (10YR 4/3) fine sandy loam; dark brown (10YR 3/3) coatings on peds; moderate fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

B1—24 to 28 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; moderate fine and medium subangular blocky structure; very friable; pebble band at 28 inches; medium acid; clear smooth boundary.

IIB21—28 to 31 inches; dark yellowish brown (10YR 4/4) loam; moderate fine and medium subangular blocky structure; firm; medium acid; clear smooth boundary.

IIB22—31 to 40 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; firm; medium acid; clear smooth boundary.

IIB23—40 to 47 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few pebbles more than 2 millimeters; medium acid; clear smooth boundary.

IIB3—47 to 53 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct yellowish brown (10YR 5/6) mottles; some brown (10YR 4/3) coatings on some vertical faces of peds; moderate medium prismatic structure; firm; few small dark reddish brown (5YR 2/2) oxides; few pebbles more than 2 millimeters; slightly acid; clear wavy boundary.

IIC—53 to 60 inches; mottled yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) loam; common fine faint yellowish brown (10YR 5/6) mottles; massive; firm; few small dark reddish brown (5YR 2/2) oxides; few pebbles more than 2 millimeters; neutral; abrupt wavy boundary.

IIC2—60 to 62 inches; mottled yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) loam; common fine faint yellowish brown (10YR 5/6) mottles; massive; firm; slight effervescence; mildly alkaline.

The solum ranges from 40 to 60 inches in thickness.

The A horizon ranges from 14 to 24 inches in thickness. It has color of (10YR 2/2), (10YR 3/2), or (10YR 2/1). It is fine sandy loam or sandy loam.

The upper part of the B horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is fine sandy loam or sandy loam. The lower part of the B horizon has hue of 10YR, value of 3 to 5, and chroma of 3 to 6. It is commonly loam but may be light clay loam or sandy clay loam. Depth to carbonates ranges from 50 to 80 inches. Reaction in the B horizon is slightly acid to strongly acid.

Palms series

The Palms series consists of very poorly drained, moderately and moderately slowly permeable soils on uplands and high stream benches. These soils formed in 20 to 50 inches of organic material over mineral material. The slope range is 1 to 4 percent.

The Palms soils in Benton County contain more mineral material in the organic part and are more sloping than is typical for the series. These differences do not alter the use or behavior of the soils.

Palms soils are commonly adjacent to Clyde and Floyd soils. They have layers of decomposed organic material more than 20 inches thick; Clyde and Floyd soils do not. They are more poorly drained than Floyd and Clyde soils.

Typical pedon in an area of Palms muck, 1 to 4 percent slopes, in a permanent pasture 1,390 feet north and 270 feet east of the southwest corner sec. 23, T. 86 N., R. 11 W.

Oa1—0 to 10 inches; black (10YR 2/1), broken face and rubbed sapric material, very dark gray (10YR 3/1) dry; fiber content 25 percent undisturbed, 10 percent rubbed; 35 percent mineral material; weak fine granular structure; very friable; neutral; gradual smooth boundary.

Oa2—10 to 26 inches; black (10YR 2/1) broken face and rubbed sapric material; fiber content 30 percent undisturbed, greater than 10 percent rubbed; 30 percent mineral material; weak coarse platy structure; very friable; neutral; clear smooth boundary.

IIA1b—26 to 32 inches; black (N 2/0) heavy silt loam; massive; friable; common roots; neutral; clear smooth boundary.

IICg—32 to 52 inches; dark gray (5Y 4/1) silt loam; massive; friable; neutral.

The depth to the IIC horizon generally ranges from 20 to 40 inches but in places is as much as 50 inches. The

Oa horizon is black (10YR 2/1) to very dark brown (10YR 2/2).

The IIA1b horizon is black (N 2/0 or 10YR 2/1). It ranges from 0 to 12 inches in thickness. It is variable in texture but is generally silt loam, silty clay loam, loam, or clay loam.

The IIC horizon ranges from black (10YR 2/1) to dark gray (5Y 4/1) and light olive gray (5Y 6/2). It is variable in texture but is typically silty clay loam, loam, or silt loam and contains sandy strata in places. Reaction in the IIC horizon is typically neutral but ranges from slightly acid to mildly alkaline.

Radford series

The Radford series consists of somewhat poorly drained, moderately permeable soils on narrow upland drainageways. These soils formed in recently deposited alluvium. The slope range is 2 to 5 percent.

Radford soils are adjacent to Nodaway soils. They have a dark buried soil at 24 to 40 inches; Nodaway soils do not.

Typical pedon in an area of Radford silt loam in an area of Nodaway-Radford, silt loams, 2 to 5 percent slopes, in a cultivated field 1,000 feet east and 1,000 feet south of the northwest corner sec. 21, T. 82 N., R. 11 W.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—11 to 17 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; few fine faint dark reddish brown (5YR 3/4) mottles; weak fine granular structure; friable; neutral; clear smooth boundary.

C—17 to 27 inches; very dark gray (10YR 3/1) with thin strata of grayish brown (10YR 5/2) silt loam; few fine faint dark reddish brown (5YR 3/4) mottles; moderate coarse prismatic structure parting to weak fine granular; friable; neutral; clear smooth boundary.

IIA11b—27 to 42 inches; black (10YR 2/1) silty clay loam; moderate very fine and fine subangular blocky structure; friable; neutral; clear smooth boundary.

IIA12b—42 to 60 inches; black (10YR 2/1) silty clay loam; moderate fine and medium subangular blocky structure; friable; neutral.

Radford soils are highly stratified in the upper 20 to 40 inches. In those horizons color is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Texture generally is silt loam, but some thin strata that are high in sand may occur. Reaction is slightly acid or neutral in the A and C horizons.

The IIA1b horizon is silty clay loam or silt loam. It is black (10YR 2/1) or very dark grayish brown (10YR 3/2).

Readlyn series

The Readlyn series consists of somewhat poorly drained, moderately permeable soils on moderately wide convex ridgetops in uplands. These soils formed in 14 to 20 inches of loamy material and in the underlying glacial till. The slope range is 1 to 3 percent.

Readlyn soils are similar to and are commonly adjacent to Kenyon and Tripoli soils. They have a grayer B horizon and are more poorly drained than Kenyon soils. They have a browner B horizon and are better drained than Tripoli soils.

Typical pedon in an area of Readlyn loam, 1 to 3 percent slopes, in a cultivated field 370 feet south and 900 feet west of the northeast corner sec. 35, T. 86 N., R. 10 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 16 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; black (10YR 2/1) coatings on peds; moderate fine and very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

A3—16 to 19 inches; very dark grayish brown (10YR 3/2) loam; moderate fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B21—19 to 23 inches; brown (10YR 4/3) loam, dark grayish brown (10YR 4/2) coatings on peds; common fine distinct yellowish brown (10YR 5/6) mottles; few fine faint dark grayish brown (10YR 4/2) mottles; moderate fine and medium subangular blocky structure; friable; pebble band at 22 to 23 inches; medium acid; clear smooth boundary.

IIB22—23 to 31 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) loam; few fine faint dark grayish brown (10YR 4/2) mottles; moderate fine and medium subangular blocky structure; firm; few pebbles more than 2 millimeters; medium acid; gradual smooth boundary.

IIB23—31 to 46 inches; yellowish brown (10YR 5/6) loam; many fine distinct grayish brown (10YR 5/2) mottles; few fine faint yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few pebbles more than 2 millimeters; slightly acid; gradual smooth boundary.

IIC—46 to 65 inches; mottled yellowish brown (10YR 5/6) and brown (10YR 5/3) loam; many fine faint grayish brown (10YR 5/2) mottles; few fine faint yellowish brown (10YR 5/8) mottles; massive; firm; few pebbles more than 2 millimeters; slight effervescence; mildly alkaline.

Solum thickness is typically 40 to 60 inches.

The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2) in the upper

part and very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) in the lower part. It ranges in thickness from about 15 to 20 inches.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 through 8.

The IIB horizon and IIC horizon are heavy loam or light clay loam. Depth to carbonates commonly coincides with solum thickness. Reaction in the B horizon is slightly acid to strongly acid.

Rockton series

The Rockton series consists of well drained, moderately permeable soils on ridgetops and side slopes in uplands. These soils formed in 20 to 30 inches of loamy material over limestone bedrock. The slope range is 2 to 9 percent.

Rockton soils are similar to Whalan and Sogn soils. They are deeper to limestone bedrock than are Sogn soils. They have a thicker and generally darker colored A1 horizon than do Whalan soils.

Typical pedon in an area of Rockton loam, 20 to 30 inches to limestone, 2 to 9 percent slopes, in a cultivated area 280 feet west and 570 feet south of the northeast corner sec. 4, T. 85 N., R. 10 W.

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—6 to 11 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; moderate fine granular structure; friable; medium acid; clear wavy boundary.

A3—11 to 17 inches; dark brown (10YR 3/3) loam; very dark grayish brown (10YR 3/2) coatings on peds; moderate fine granular structure; friable; medium acid; clear wavy boundary.

B21t—17 to 24 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) coatings on peds; moderate fine subangular blocky structure; friable; thin patchy clay films; strongly acid; abrupt wavy boundary.

IIB22t—24 to 26 inches; dark yellowish brown (10YR 3/4) clay; moderate fine subangular blocky structure; firm; thin continuous clay films on peds; slightly acid; abrupt wavy boundary.

R—26 inches; limestone bedrock, shattered in the upper 2 to 3 feet.

Solum thickness and depth to limestone bedrock ranges from 20 to 30 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is 10 to 18 inches thick. It is typically loam, but silt loam is within the range.

The B2t horizon has value of 3 to 5 and chroma of 3 or 4, and hue of 10YR in the upper part and 7.5YR or 10YR in the lower part. Reaction ranges from medium to

strongly acid. The B2t horizon is about 25 to 35 percent clay.

Some profiles have a IIB horizon, which formed in residuum of limestone. It may be only evident by rinds around limestone flags or may be as much as 6 inches thick. The IIB horizon is heavy clay loam, clay, or silty clay.

Sattre series

The Sattre series consists of well drained soils that are moderately permeable in the upper part and very rapidly permeable in the lower part. They are on benches along rivers and streams. These soils formed in 32 to 40 inches of loamy material and in the underlying sand and gravel. The slope range is 0 to 5 percent.

Sattre soils are similar to Waukee, Saude, Lawler, and Udolpho soils. They have a thinner dark colored A horizon than do Waukee, Saude, and Lawler soils. They have a browner B horizon and are better drained than Lawler and Udolpho soils.

Typical pedon in an area of Sattre loam, 0 to 2 percent slopes, in a hayfield 550 feet east and 1,250 feet south of the center sec. 2, T. 85 N., R. 10 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A2—8 to 13 inches; dark grayish brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) coatings on peds; discontinuous light brownish gray (10YR 6/2) sand and silt coatings on peds when dry; weak medium platy structure; friable; slightly acid; clear wavy boundary.

B1—13 to 17 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) coatings on peds; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; slightly acid; gradual smooth boundary.

B21t—17 to 24 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 4/3) coatings on peds; light brownish gray (10YR 6/2) silt and sand coatings on peds when dry; moderate medium angular and subangular blocky structure; friable; few thin discontinuous clay films on peds; clay lined channels and pores; medium acid; gradual smooth boundary.

B22t—24 to 32 inches; dark yellowish brown (10YR 4/4) loam; dark brown (10YR 4/3) coatings on peds; moderate medium angular and subangular blocky structure; friable; thin nearly continuous clay films on peds; medium acid; clear smooth boundary.

B31t—32 to 35 inches; yellowish brown (10YR 5/6) sandy loam; moderate coarse subangular blocky structure; friable; thin discontinuous dark yellowish brown (10YR 4/3) clay films on peds; medium acid; clear smooth boundary.

IIB32t—35 to 40 inches; yellowish brown (10YR 5/6) sand; weak coarse subangular blocky structure; very

friable; clay bridging between sand grains; medium acid; gradual smooth boundary.

IIC1—40 to 60 inches; brownish yellow (10YR 6/6) sand; single grained; loose; 1 inch thick brown (7.5YR 5/4) bands of clay at 45, 49, and 53 inches.

Solum thickness ranges from about 30 to 50 inches. Thickness of the solum may or may not correspond to the depth to loamy sand or sand. Depth to these materials ranges from 32 to 40 inches.

The A1 or Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). It ranges from 6 to 10 inches in thickness. The A2 horizon is commonly brown (10YR 4/3 or 5/3) or dark grayish brown (10YR 4/2). In some eroded areas, the A2 horizon may be wholly incorporated in the Ap horizon.

The B2 horizon is loam, light clay loam, or light sandy clay loam that grades to sandy loam or loamy sand in the B3 horizon. Clay content of the B2 ranges from 18 to 22 percent.

The C horizon ranges from loamy sand to sand and gravel. The content of gravel is variable, ranging from low in places to 20 to 30 percent by volume in some strata. Reaction is medium acid or strongly acid in the most acid part of the solum.

Saude series

The Saude series consists of well drained soils that are moderately permeable in the upper part and very rapidly permeable in the lower part. These soils are on benches along rivers or major streams. They formed in 24 to 32 inches of loamy material and in the underlying sandy material. The slope range is 0 to 9 percent.

Saude soils are similar to Waukee, Lawler, and Sattre soils. They have a thicker A1 horizon than do Sattre soils. They are better drained and have a browner B horizon than do Lawler soils. They are shallower over underlying sandy material than are Waukee soils.

Typical pedon in an area of Saude loam, 2 to 5 percent slopes, in a cultivated field 830 feet west and 40 feet south of the northeast corner sec. 19, T. 84 N., R. 9 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; moderate very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

B1—13 to 17 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on peds; moderate very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

B21—17 to 25 inches; brown (10YR 4/3) loam; moderate very fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

B22—25 to 27 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; moderate very fine subangular blocky structure; very friable; medium acid; abrupt smooth boundary.

IIC—27 to 60 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) gravelly sand; single grained; loose; medium acid.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2), unless the soil has been eroded. Total thickness of the A horizon typically ranges from 10 to 16 inches.

The B horizon typically has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The B horizon ranges from 12 to 20 percent clay.

The C horizon is typically medium and coarse loamy sand and sand with some gravel. Depth to loamy sand, gravelly sand, and sand typically ranges from 24 to 32 inches with an extreme range of about 18 to 36 inches. The coarse material is acid. Carbonates are leached to 6 feet or more. The percentage by volume of gravel ranges from 5 to 15 percent.

Schley series

The Schley series consists of somewhat poorly drained, moderately permeable soils on straight to concave heads of upland drainageways or on side slopes along drainageways. These soils formed in 30 to 50 inches of loamy and sandy stratified material and in the underlying firm loam glacial till. The slope range is 1 to 4 percent.

Schley soils are similar to Floyd and Clyde soils. They are commonly adjacent to Kenyon, Bassett, Floyd, and Clyde soils. Schley soils have a thinner A1 horizon than do Kenyon, Clyde, and Floyd soils. They are more poorly drained than Kenyon and Bassett soils but better drained than Clyde soils.

Typical pedon in an area of Schley loam, 1 to 4 percent slopes, in a cultivated field 290 feet west and 2,125 feet north of the center sec. 30, T. 86 N., R. 9 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam; dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A21—7 to 13 inches; dark grayish brown (10YR 4/2) loam; light brownish gray (10YR 6/2) dry; moderate very thin platy structure; friable; strongly acid; clear smooth boundary.

A22—13 to 18 inches; brown (10YR 4/3) loam; light brownish gray (10YR 6/2) dry; common fine faint yellowish brown (10YR 5/4) mottles; moderate very thin platy structure; friable; strongly acid; clear wavy boundary.

B21—18 to 24 inches; grayish brown (2.5Y 5/2) loam; common fine distinct yellowish brown (10YR 5/6)

mottles; moderate fine subangular blocky structure; friable; very strongly acid; clear smooth boundary.

B22t—24 to 30 inches; grayish brown (2.5Y 5/2) loam; many fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; friable; thin discontinuous clay films; strongly acid; clear smooth boundary.

B23t—30 to 45 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) sandy loam; few fine distinct yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; friable; clay bridging between sand grains; few pebbles more than 2 millimeters; medium acid; clear smooth boundary.

IIB24t—45 to 52 inches; mottled grayish brown (2.5Y 5/2), yellowish brown (10YR 5/4), and brown (7.5YR 5/4) loam; moderate medium subangular blocky structure; firm; few thin clay films; slightly acid; clear smooth boundary.

IIB3—52 to 60 inches; mottled yellowish brown (10YR 5/6) and gray (5Y 5/1) loam; weak coarse prismatic structure; firm; slightly acid.

The solum is commonly about 50 inches thick but ranges to 60 inches or more.

The Ap or A1 horizon is typically very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2), but the A1 horizon is black (10YR 2/1) in some places. The A2 horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3), or grayish brown (10YR 5/2) with higher chroma mottles. It ranges from about 8 to 12 inches in thickness. The A horizon is loam or silt loam high in content of sand.

The B2 horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 4. It ranges from loam and silt loam high in sand content to heavy sandy loam. Reaction of the B2 horizon ranges from medium acid to very strongly acid. A pebble band commonly separates the overlying stratified material and the glacial till. Loamy sand may occur in this zone.

The IIB3 and IIC horizons are typically mottled 7.5YR, 10YR, 2.5Y, and 5Y hue with value of 4 to 6 and chroma of 1 to 6. They are typically heavy loam, light clay loam, or sandy clay loam.

Sogn series

The Sogn series consists of somewhat excessively drained, moderately permeable soils on ridgetops and side slopes in uplands. These soils formed in 4 to 20 inches of loamy material over limestone bedrock. The slope range is 5 to 40 percent. The Sogn soils in Benton County have a more moist climate and are steeper than is typical for the series. These differences do not alter the use or behavior of the soils.

Sogn soils are similar to Rockton, Whalan, and Backbone soils but are shallower over bedrock than those soils.

Typical pedon in an area of Sogn loam, 9 to 18 percent slopes, in a wooded area 510 feet south and 520

feet east of the northwest corner sec. 10, T. 85 N., R. 9 W.

A11—0 to 4 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A12—4 to 10 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; very dark grayish brown (10YR 3/2) coatings on peds; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A3—10 to 12 inches; dark brown (10YR 3/3) heavy loam; moderate fine and medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

R—12 inches; shattered and fractured limestone.

Thickness of the solum and depth to limestone is 4 to 15 inches. The A1 horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), dark brown (10YR 3/3), or very dark grayish brown (10YR 3/2). It is 5 to 15 inches thick. An A3 horizon occurs in some profiles. It is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). The A horizon ranges from loam to heavy sandy loam or light clay loam. In some places 1 to 4 inches of clay or silty clay material is just above the limestone.

Sparta series

The Sparta series consists of excessively drained soils that are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. They are on benches and in uplands. They formed in sand that was deposited dominantly by wind. The slope range is 0 to 14 percent.

Sparta soils are similar to Chelsea soils. They have a darker colored A1 horizon than do Chelsea soils and do not have the banded A & B horizon characteristic of those soils.

Typical pedon in an area of Sparta loamy fine sand, 2 to 5 percent slopes, in a hayfield 900 feet north and 140 feet west of the center sec. 33, T. 86 N., R. 10 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to single grained; very friable; medium acid; gradual smooth boundary.

A12—8 to 20 inches; very dark grayish brown (10YR 3/2) loamy fine sand, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to single grained; very friable; medium acid; gradual wavy boundary.

B2—20 to 28 inches; brown (10YR 4/3) loamy fine sand; weak medium subangular blocky structure parting to single grained; very friable; medium acid; gradual wavy boundary.

C—28 to 72 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; medium acid.

Thickness of the solum ranges from 24 to about 40 inches. Thickness of the mollic epipedon ranges from 13 to 24 inches.

The A horizon ranges from loamy fine sand to loamy sand or fine sand.

The B horizon has hue of 10YR and value and chroma of 3 to 6. It is fine sand, loamy sand, or loamy fine sand. Fine and medium sand are dominant throughout the control section. Reaction is medium acid to strongly acid in the B horizon.

Sperry series

The Sperry series consists of poorly drained or very poorly drained, slowly and very slowly permeable soils on nearly level to slightly depressional areas in uplands. The slope range is 0 to 1 percent.

Sperry soils are similar to Atterberry and Muscatine soils. Sperry soils have an A2 horizon; Muscatine soils do not. They have a grayer B horizon than do Muscatine soils. Sperry soils have a thicker A1 horizon and a grayer B horizon than Atterberry soils.

Typical pedon in an area of Sperry silt loam, 0 to 1 percent slopes, in a cultivated field 310 feet east and 160 feet south of the center sec. 27, T. 83 N., R. 12 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam; dark gray (10YR 4/1) dry; weak very fine granular structure; friable; some partly decomposed plant material; slightly acid; abrupt smooth boundary.

A12—9 to 14 inches; very dark gray (10YR 3/1) heavy silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; some partly decomposed plant material; slightly acid; clear smooth boundary.

A21—14 to 18 inches; dark gray (10YR 4/1) silt loam; gray (10YR 6/1) dry; very dark gray (10YR 3/1) coatings on peds; moderate medium platy structure parting to weak fine subangular blocky; friable; medium acid; clear smooth boundary.

A22—18 to 22 inches; dark gray (10YR 4/1) silt loam; gray (10YR 6/1) dry; very dark gray (10YR 3/1) coatings on peds; moderate medium platy structure; friable; medium acid; abrupt smooth boundary.

B21t—22 to 26 inches; black (10YR 2/1) light silty clay; few fine distinct yellowish brown (10YR 5/4) mottles; moderate very fine subangular blocky structure; firm; thin continuous clay films on ped surfaces; medium acid; clear smooth boundary.

B22t—26 to 31 inches; very dark gray (10YR 3/1) heavy silty clay loam; few fine faint dark gray (10YR 4/1) mottles; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; slightly acid; clear smooth boundary.

B23t—31 to 37 inches; dark gray (5Y 4/1) heavy silty clay loam; very dark gray (10YR 3/1) coatings on

some peds; few fine faint gray (5Y 5/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin nearly continuous clay films on prisms and peds; slightly acid; gradual smooth boundary.

B31t—37 to 46 inches; dark gray (10YR 4/1) silty clay loam; very dark gray (10YR 3/1) coatings on prism faces; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; firm; slightly acid; gradual wavy boundary.

C—46 to 60 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; slightly acid.

Solum thickness ranges from 45 to more than 60 inches. The A1 horizon is 10 to 14 inches thick. It is black (10YR 2/1 or N 2/0) or very dark gray (10YR 3/1) silt loam. The A2 horizon is 6 to 10 inches thick. It is silt loam, and typically is very dark gray (10YR 4/1).

The B horizon is black (10YR 2/1) to dark gray (5Y 5/1) heavy silty clay loam or light silty clay. Reaction in the B horizon ranges from slightly acid to strongly acid.

Spillville series

The Spillville series consists of moderately well drained and somewhat poorly drained, moderately permeable soils formed in medium textured alluvium on level flood plains along rivers and streams. The slope range is 0 to 2 percent.

Spillville soils are commonly adjacent to Colo, Hanlon, and Nodaway soils. They are better drained and contain less clay and more sand than the Colo soils. They contain less sand than the Hanlon soils. They are darker colored, contain more sand, and are less stratified than the Nodaway soils.

Typical pedon in an area of Spillville loam, 0 to 2 percent slopes, in a bluegrass pasture 1,260 feet north and 50 feet west of the southeast corner sec. 18, T. 86 N., R. 12 W.

A11—0 to 21 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; friable; slightly acid; gradual smooth boundary.

A12—21 to 40 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) rubbed; moderate fine and medium subangular blocky structure; friable; slightly acid; gradual smooth boundary.

A13—40 to 52 inches; very dark grayish brown (10YR 3/2) loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; slightly acid; clear smooth boundary.

C—52 to 60 inches; brown (10YR 4/3) fine sand; single grained; loose; medium acid.

The solum thickness ranges from 40 to 60 inches. Reaction in the solum is commonly neutral or slightly acid.

The A horizon is typically black (10YR 2/1) or very dark brown (10YR 2/2), but in some profiles it is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1) in the lower part. These colors extend to a depth of 36 inches or more. Texture of the A horizon is typically loam but may be silt loam high in content of sand.

Below the A horizon is either a B or C horizon with hue commonly of 10YR, value of 3 or 4, and chroma of 1 to 3. It is commonly loam but may be sandy loam with strata of loamy sand or sand below 40 inches.

Tama series

The Tama series consists of well drained, moderately permeable soils on loess covered uplands and some loess covered benches. The slope range is 0 to 9 percent.

Tama soils are commonly adjacent to Muscatine and Dinsdale soils. Tama soils have a browner B horizon and are better drained than the Muscatine soils. Tama soils, formed in silty material more than 48 inches thick, have less sand in the lower part of the B horizon than do Dinsdale soils.

Typical pedon in an area of Tama silty clay loam, 2 to 5 percent slopes, in a cultivated area 530 feet north and 100 feet west of southeast corner sec. 30, T. 86 N., R. 12 W.

Ap—0 to 8 inches; black (10YR 2/1) light silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—8 to 15 inches; very dark grayish brown (10YR 3/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) coatings on peds; moderate fine and very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B1—15 to 18 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) coatings on peds; moderate fine and very fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B21t—18 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on peds; moderate fine subangular blocky structure; friable; very thin continuous clay films on surfaces of peds; medium acid; gradual smooth boundary.

B22t—27 to 36 inches; dark yellowish brown (10YR 4/4) silty clay loam; brown (10YR 4/3) coatings on peds; moderate fine and medium subangular blocky structure; friable; very thin continuous clay films on surface of peds; slightly acid; gradual smooth boundary.

B3—36 to 44 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) light silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles;

few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine dark reddish brown (5YR 2/2) oxides; friable; slightly acid; gradual smooth boundary.

C1—44 to 56 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) silt loam; massive; friable; slightly acid; abrupt wavy boundary.

IIC2—56 to 64 inches; yellowish brown (10YR 5/4) sandy loam; single grained; loose; neutral; abrupt wavy boundary.

IIC3—64 to 66 inches; yellowish brown (10YR 5/4) loam; massive; friable; neutral.

Solum thickness ranges from about 40 to 60 inches.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It ranges from 13 to 20 inches in thickness unless eroded. The A horizon is typically silty clay loam but ranges to silt loam.

The B horizon typically has hue of 10YR, value of 3 to 5, and chroma of 3 to 6. The B2t horizon ranges from 27 to 35 percent in clay content. Depth to grayish mottles is about 30 to 50 inches. Reaction is slightly acid to strongly acid in the B horizon.

The Tama silty clay loam, 5 to 9 percent slopes, moderately eroded, map unit is Tama soils with mollic epipedons that are not as thick as the defined range of the Tama series. This difference does not alter the use or behavior of these soils.

Tripoli series

The Tripoli series consists of poorly drained, moderately permeable soils on broad, nearly level ridgetops in uplands. These soils formed in 18 to 24 inches of loamy material and in the underlying glacial till. The slope range is 0 to 2 percent.

Tripoli soils are similar to Kenyon and Readlyn soils. They are commonly adjacent to Clyde and Floyd soils. Tripoli soils are more poorly drained and have a grayer B horizon than the Floyd, Kenyon, and Readlyn soils. They are shallower over firm loam glacial till and over carbonates than are Clyde soils.

Typical pedon in an area of Tripoli clay loam, 0 to 2 percent slopes, in a cultivated field 1,180 feet north and 1,230 feet east of the center sec. 13, T. 86 N., R. 10 W.

Ap—0 to 7 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—7 to 12 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A13—12 to 17 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.

B1g—17 to 21 inches; dark grayish brown (2.5Y 4/2) clay loam; very dark gray (10YR 3/1) and dark gray

(10YR 4/1) coatings on peds; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; few hard strong brown (7.5YR 5/6) oxides; neutral; clear smooth boundary.

B21g—21 to 24 inches; dark grayish brown (2.5Y 4/2) clay loam; discontinuous dark gray (10YR 4/1) coatings on peds; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; stone line at 24 inches; neutral; abrupt smooth boundary.

IIB22—24 to 27 inches; olive brown (2.5Y 4/4) heavy loam; discontinuous dark gray (10YR 4/1) coatings on peds; weak medium subangular blocky structure; friable; few hard light olive brown (2.5Y 4/4) oxides; neutral; clear smooth boundary.

IIB23—27 to 39 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) heavy loam; weak coarse subangular blocky structure; firm; few hard very dark brown (7.5YR 2/2) and strong brown (7.5YR 5/6) oxides; neutral; abrupt wavy boundary.

IIC—39 to 60 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (2.5 6/2) heavy loam; massive; firm; common fine distinct soft white lime accumulations; slight effervescence; mildly alkaline.

The solum thickness ranges from about 36 to 50 inches.

The A horizon is black (N 2/0 or 10YR 2/1) in the upper part and very dark gray (10YR 3/1 or 5Y 3/1) in the lower part. It ranges from 15 to 22 inches in thickness. It ranges from silty clay loam high in content of sand to clay loam.

The IIB2 horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 to 6 with higher chroma mottles. The IIB horizon and IIC horizon are generally heavy loam but range to light clay loam. Carbonates typically occur within a depth of 60 inches. Reaction ranges from neutral to slightly acid in the A horizon and from neutral to mildly alkaline in the B horizon.

Udolpho series

The Udolpho series consists of somewhat poorly drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. They are on benches along streams and rivers. These soils formed in 32 to 40 inches of loamy material and in the underlying coarse textured material. The slope range is 0 to 2 percent.

Udolpho soils are similar to and associated with Waukee, Saudee, Sattre, and Lawler soils. They have a grayer B horizon and are more poorly drained than the Waukee, Saudee, and Sattre soils. They have a thinner A1 horizon than do Lawler soils.

Typical pedon in an area of Udolpho loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes, in a cultivated field 1,056 feet west and 1,160 feet south of the center sec. 15, T. 86 N., R. 10 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; neutral.

A2—7 to 16 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) loam, light gray (10YR 7/2) dry; moderate thin platy structure; friable; many fine distinct dark brown (7.5YR 3/2) and dark reddish brown (5YR 3/4) soft oxides; slightly acid; abrupt smooth boundary.

B1—16 to 21 inches; dark grayish brown (10YR 4/2) loam; grayish brown (10YR 5/2) coatings on peds; moderate medium subangular blocky structure; friable; common fine distinct dark brown (7.5YR 3/2) and reddish brown (5YR 4/4) oxides; medium acid; clear wavy boundary.

B21t—21 to 28 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) loam; moderate medium subangular blocky structure; friable; common fine distinct dark brown (7.5YR 3/2 and 4/4) oxides; clay flows in pores and root channels; thin patchy clay films on ped faces; strongly acid; gradual wavy boundary.

B22t—28 to 36 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) light loam; weak medium subangular blocky structure; friable; common fine distinct dark brown (7.5YR 3/2 and 4/4) oxides; thin discontinuous clay films on ped faces; strongly acid; abrupt wavy boundary.

IIB3—36 to 40 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) loamy sand with some gravel; weak coarse subangular blocky structure; very friable; common fine distinct dark brown (7.5YR 3/2 and 4/4) oxides; strongly acid; clear smooth boundary.

IIC—40 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grained; loose; strongly acid.

Solum thickness ranges from about 24 to 40 inches. Depth to underlying coarse textured material, or contrasting textures, ranges from about 32 to 40 inches.

The A1 or Ap horizon ranges from 6 to 10 inches in thickness. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A2 horizon has matrix value of 4 or 5 and chroma of 2 or 3. It is 3 to 10 inches thick.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2.

The upper part of the B horizon is typically loam, silt loam high in content of sand, or light clay loam.

The lower part of the B horizon is sandy loam or loamy sand in some places. The lower part of the B horizon or the C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. Reaction is medium or strongly acid in the B horizon. The C horizon is dominantly loamy sand, coarse sand, or sand with some gravel.

Vesser series

The Vesser series consists of somewhat poorly drained or poorly drained, moderately permeable soils in level or slightly depressed areas on flood plains along major streams or on low stream benches. The slope range is 0 to 2 percent. The Vesser soils in Benton County have a thinner and more weakly expressed albic horizon than is typical for the Vesser series. This difference does not alter the use or behavior of the soils.

Vesser soils are commonly adjacent to Colo, Nevin, and Bremer soils. Vesser soils do not have as thick an A1 horizon as do Colo, Nevin, and Bremer soils. Vesser soils have a light colored A2 horizon; the Colo, Nevin and Bremer soils do not.

Typical pedon in an area of Vesser silt loam, 0 to 2 percent slopes, in a cultivated field 1,120 feet west and 1,000 feet north of the southeast corner sec. 24, T. 86 N., R. 11 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) heavy silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 11 inches; very dark gray (10YR 3/1) heavy silt loam, gray (10YR 5/1) dry; few fine distinct dark reddish brown (2.5YR 2/4) mottles; moderate fine granular structure; friable; medium acid; abrupt smooth boundary.

A21—11 to 15 inches; very dark gray (10YR 3/1) silt loam; gray (10YR 6/1) dry; many fine faint dark gray (10YR 4/1) mottles; moderate medium platy structure; friable; strongly acid; clear wavy boundary.

A22—15 to 19 inches; very dark gray (10YR 3/1) silt loam; continuous light gray (10YR 7/1) coatings on peds; fine distinct dark brown (7.5YR 4/4) mottles; moderate medium platy structure; friable; strongly acid; abrupt wavy boundary.

B21t—19 to 31 inches; black (10YR 2/1) medium to heavy silty clay loam; few patchy gray (10YR 6/1) coatings on peds; few fine distinct reddish brown (5YR 4/4) and few fine faint dark gray (10YR 4/1) mottles; moderate medium prismatic structure parting to fine subangular blocky and angular blocky; firm; few thin continuous clay films on peds; strongly acid; clear smooth boundary.

B22tg—31 to 39 inches; mottled dark gray (5Y 4/1) and gray (5Y 5/1) heavy silty clay loam; very dark gray (10YR 3/1) coatings on peds and prisms; common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to fine subangular blocky and angular blocky; firm; thin nearly continuous clay films on prisms and peds; strongly acid; clear smooth boundary.

B23tg—39 to 45 inches; dark gray (5Y 4/1) silty clay loam; very dark gray (10YR 3/1) coatings on some prisms; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; thin patchy

clay films on prism faces; strongly acid; clear smooth boundary.

B24tg—45 to 54 inches; light gray (5Y 6/1) light silty clay loam; common fine and medium prominent reddish brown (5YR 4/4) and yellowish red (5YR 4/6) mottles; moderate medium prismatic structure; firm; thin patchy clay films on prism faces; dark stains in root channels; medium acid; clear smooth boundary.

B3g—54 to 60 inches; light gray (5Y 6/1) light silty clay loam; gray (5Y 5/1) coatings on some prisms; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; slightly acid.

Solum thickness ranges from 50 to 70 inches or more.

The A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The A1 horizon ranges from heavy silt loam to light silty clay loam. It is 11 to 20 inches thick. The A2 horizon ranges from very dark gray (10YR 3/1) or dark gray (10YR 4/1) to grayish brown (10YR 5/2). The A2 horizon is silt loam. It is 8 to 20 inches thick.

The B2tg horizon has hue of 10YR or 5Y, value of 3 through 6, and chroma of 1 or 2. The B2tg horizon is heavy to light silty clay loam. Reaction in the B2 horizon is medium acid or strongly acid.

Walford series

The Walford series consists of poorly drained or very poorly drained, slowly permeable soils in flat or slightly depressed areas on loess covered high stream benches. The slope range is 0 to 1 percent.

Walford soils are similar to the bench phases of Atterberry, Muscatine, and Tama soils. They have a thicker and more prominent A2 horizon than do Atterberry soils. They have an A2 horizon; the Muscatine and Tama soils do not. They have a grayer B horizon and are more poorly drained than the Atterberry, Muscatine, and Tama soils.

Typical pedon in an area of Walford silt loam, sandy substratum, 0 to 1 percent slopes, in a cultivated field 860 feet east and 660 feet north of the southwest corner sec. 19, T. 86 N., R. 10 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few fine distinct brown (7.5YR 4/4) oxide concretions; slightly acid; abrupt smooth boundary.

A2—8 to 16 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; very dark grayish brown (10YR 3/2) coatings on peds; few fine faint brown (7.5YR 4/4) mottles; weak thick platy structure; friable; medium acid; clear smooth boundary.

B1—16 to 21 inches; grayish brown (10YR 5/2) light silty clay loam; gray (10YR 5/1) coatings on peds; many medium distinct yellowish brown (10YR 5/6) mottles;

moderate fine subangular blocky structure; friable; many faint light gray (10YR 7/1) silt coatings on peds dry; few fine brown (7.5YR 4/4) oxide concretions; medium acid; clear smooth boundary.

B21t—21 to 28 inches; gray (10YR 5/1) silty clay loam; light gray (10YR 6/1) coatings on peds, many medium distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; firm; few thin discontinuous clay films; nearly continuous white (10YR 8/1) silt coatings on peds dry; medium acid; gradual smooth boundary.

B22t—28 to 38 inches; gray (10YR 5/1) silty clay loam; dark gray (10YR 4/1) coatings on peds; many medium distinct yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure; firm; discontinuous clay films on surfaces of peds and in root channels; many fine brown (7.5YR 4/4) oxide concretions; medium acid; gradual smooth boundary.

B31t—38 to 47 inches; gray (10YR 5/1) light silty clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; few thick discontinuous very dark gray (10YR 3/1) clay films on surfaces of peds and in root channels; common fine brown (7.5YR 4/4) oxide concretions; medium acid; abrupt smooth boundary.

11B32—47 to 60 inches; yellowish brown (10YR 5/4) gravelly loamy sand; few fine faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; very friable; slightly acid.

Solum thickness ranges from 50 to 70 inches.

The A1 or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. The A2 horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 1 or 2. It ranges from 6 to 14 inches thick.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 1 or 2 with higher chroma mottles. Clay content of the Bt horizon ranges from 32 to 38 percent with a weighted clay average of less than 35 percent. Depth to loamy sand or gravelly loamy sand is 45 to 58 inches. Reaction is medium acid to strongly acid in the most acid part of the B horizon.

Waubeek series

The Waubeek series consists of moderately well drained, moderately permeable soils in uplands. These soils formed in 24 to 40 inches of loess and in the underlying glacial till. The slope range is 2 to 9 percent.

Waubeek soils are similar to Dinsdale, Klinger, and Maxfield soils. They have a thinner A horizon than do those soils. They have a browner B horizon and are better drained than the Klinger and Maxfield soils.

Typical pedon in an area of Waubeek silt loam, 2 to 5 percent slopes, in a pasture 1,700 feet east and 327 feet north of the center sec. 2, T. 85 N., R. 11 W.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
- B1t—7 to 11 inches; brown (10YR 4/3) light silty clay loam, pale brown (10YR 6/3) dry; some dark brown (10YR 3/3) coatings on peds; moderate very fine granular structure; friable; thin discontinuous clay films on ped faces; slightly acid; clear smooth boundary.
- B21t—11 to 16 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine subangular blocky structure; friable; thin nearly continuous clay films on ped faces; strongly acid; clear smooth boundary.
- B22t—16 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam; dark brown (10YR 4/3) coatings on peds; moderate fine and very fine subangular blocky structure; friable; few light grayish brown (10YR 6/2) silt coatings on peds, dry; thin nearly continuous clay films on ped faces; strongly acid; gradual boundary.
- B23t—23 to 33 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium and fine subangular blocky structure; friable; light grayish brown (10YR 6/2) silt coatings on peds, dry; thin nearly continuous clay films on ped faces; stone line at 33 inches; strongly acid; abrupt smooth boundary.
- IIB24t—33 to 36 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) light loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; light brownish gray (10YR 6/2) silt coatings on peds, dry; thin discontinuous clay films on peds and sand grains; faint stone line at 36 inches; strongly acid; abrupt smooth boundary.
- IIB25t—36 to 46 inches; yellowish brown (10YR 5/6) heavy loam; grayish brown (2.5Y 5/2) coatings on some prism faces; many fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films on peds; medium acid; gradual wavy boundary.
- IIB3t—46 to 59 inches; mottled yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) heavy loam; moderate medium prismatic structure; firm; thin discontinuous brown (10YR 4/3) clay films on some prism faces and in root channels; medium acid; abrupt wavy boundary.
- IIC—59 to 63 inches; yellowish brown (10YR 5/4) heavy loam; common medium distinct grayish brown (2.5Y 5/2) mottles; heavy loam; massive; firm; slight effervescence; neutral.

The solum thickness is typically more than 45 inches and ranges from 42 to 60 inches. The loess is commonly 24 to 40 inches thick and ranges from 20 to 40 inches.

The A1 or Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray

(10YR 3/1). It is 6 to 10 inches thick. If an A2 horizon occurs, it is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). In some cultivated or eroded areas, the A2 horizon is completely incorporated into the Ap horizon. In some pedons, the Ap horizon is underlain abruptly by a B1 horizon that is brown (10YR 4/3) and has dark brown (10YR 3/3) coatings on peds.

The upper part of the B horizon is silty clay loam with 28 to 33 percent clay. It has hue of 10YR, value of 4 or 5, and chroma of 3 to 5. The lower part of the B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 8 with few to common low chroma mottles. The lower B horizon ranges from loam or sandy clay loam to light clay loam. Lenses of sandy loam or loamy sand as much as 10 inches thick are between the loess and the glacial till in places. Reaction ranges from medium to strongly acid in the B horizon.

Waukee series

The Waukee series consists of well drained soils that are moderately permeable in the upper part and are very rapidly permeable in the lower part. They are on benches. They formed in 32 to 40 inches of loam and in the underlying coarse sand and gravel. The slope range is 0 to 5 percent.

Waukee soils are similar to Saude, Sattre, and Lawler soils. They are deeper to coarse textured material than the Saude soils. They have a thicker A1 horizon than do Sattre soils. They have a browner B horizon and are better drained than Lawler soils.

Typical pedon in an area of Waukee loam, 0 to 2 percent slopes, in a cultivated field 1,475 feet west and 75 feet north of the southeast corner sec. 25, T. 86 N., R. 10 W.

- Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.
- A12—8 to 16 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; slightly acid; clear smooth boundary.
- B1—16 to 23 inches; very dark grayish brown (10YR 3/2) loam; very dark brown (10YR 2/2) coatings on peds; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.
- B21—23 to 27 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) coatings on some peds; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.
- B22—27 to 35 inches; dark yellowish brown (10YR 4/4) loam; dark brown (10YR 3/3) coatings on peds; moderate medium subangular blocky structure; friable; medium acid; abrupt smooth boundary.
- B3—35 to 37 inches; dark yellowish brown (10YR 4/4) sandy loam with some gravel; dark brown (10YR

3/3) coatings on some peds; weak medium subangular blocky structure; very friable; neutral; abrupt wavy boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) coarse sand with some gravel; single grained; loose; neutral.

Thickness of the solum may or may not correspond to the depth to coarse loamy sand or gravelly sand. Depth to sandy and gravelly material is typically 32 to 40 inches.

The A1 or Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is loam or silt loam high in content of sand. The A horizon ranges from 13 to 18 inches in thickness.

The B2 horizon typically has hue of 10YR, value of 4 or 5, and chroma of 3 through 6. The B2 horizon is loam, sandy clay loam, or heavy sandy loam. It ranges from about 18 to 24 percent clay. Reaction is medium or strongly acid in the B horizon.

The C horizon is loamy coarse sand, coarse sand, gravelly sand, or sand. It is about 10 to 20 percent gravel but ranges to as much as 20 to 50 percent by volume in some places.

Waukegan series

The Waukegan series consists of well drained soils that are moderately permeable in the upper part and are rapidly permeable in the lower part. They are on benches. They formed in 24 to 40 inches of silty material and in the underlying sandy material. The slope range is 0 to 5 percent.

Waukegan soils are similar to Whittier soils. They are associated with Waukee soils. They have a thicker and generally darker colored A horizon than do Whittier soils. They contain less sand in the upper part of the solum than do Waukee soils.

Typical pedon in an area of Waukegan silt loam, 0 to 2 percent slopes, in a cultivated area 60 feet west and 915 feet south of the center sec. 29, T. 82 N., R. 12 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

B1—13 to 18 inches; brown (10YR 4/3) light silty clay loam; dark brown (10YR 3/3) coatings on peds; moderate very fine subangular blocky structure; friable; medium acid; clear wavy boundary.

B21—18 to 25 inches; dark yellowish brown (10YR 4/4) light silty clay loam; moderate medium subangular blocky structure; friable; medium acid; gradual smooth boundary.

B22—25 to 33 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; few light brownish gray (10YR 6/2) silt coatings on peds; medium acid; abrupt smooth boundary.

B23—33 to 36 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; medium acid; abrupt smooth boundary.

IIB3—36 to 49 inches; yellowish brown (10YR 5/4) loamy sand; single grained; loose; medium acid; clear wavy boundary.

IIC1—49 to 60 inches; yellowish brown (10YR 5/6) sand; single grained; loose; medium acid.

Thickness of the solum ranges from 42 to about 60 inches. Depth to contrasting textures ranges from about 30 to 40 inches.

The A1 horizon is typically black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). If an A3 horizon occurs, it is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). Total thickness of the A horizon ranges from 10 to 17 inches.

The B2 horizon typically has hue of 10YR, value of 4 or 5, and chroma of 3 through 6. It is typically silty clay loam but ranges to silt loam, loam, and loamy sand. Reaction in the B horizon ranges from medium to strongly acid.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 through 6. It is stratified loamy sand and sand.

Whalan series

The Whalan series consists of well drained soils that are moderately permeable in the upper part and moderately slowly or slowly permeable in the lower part. They are on ridgetops and side slopes in uplands. These soils formed in 20 to 30 inches of loamy material over limestone bedrock. The slope range is 2 to 9 percent.

Whalan soils are similar to Rockton soils but have a thinner and generally lighter colored A1 horizon than do those soils.

Typical pedon in an area of Whalan loam, 20 to 30 inches to limestone, 2 to 9 percent slopes, in a pasture 1,260 feet north and 490 feet west of the center sec. 14, T. 85 N., R. 10 W.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) light loam; grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A2—2 to 5 inches; brown (10YR 4/3) light loam; light brownish gray (10YR 6/2) dry; weak fine platy structure; friable; medium acid; clear wavy boundary.

B1—5 to 10 inches; dark yellowish brown (10YR 4/4) loam; light brownish gray (10YR 6/2) sand and silt coatings on peds dry; some dark brown (10YR 3/3) coats on peds; moderate fine angular blocky structure; friable; medium acid; clear wavy boundary.

B21t—10 to 16 inches; dark yellowish brown (10YR 4/4) heavy loam; moderate fine and medium angular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films on peds; medium acid; gradual smooth boundary.

B22t—16 to 26 inches; dark yellowish brown (10YR 4/4) heavy loam; moderate fine and medium angular blocky structure; friable; thin discontinuous clay films on peds; medium acid; clear wavy boundary.

IIB23t—26 to 28 inches; dark yellowish brown (10YR 4/4) silty clay; moderate fine subangular blocky structure; firm; thin continuous clay films on peds; few dark (10YR 3/3) stains on peds; about 50 percent by volume limestone fragments; neutral; abrupt wavy boundary.

R—28 inches; fragmented limestone.

Solum thickness and depth to limestone bedrock is 20 to 30 inches.

The A1 horizon ranges from 2 to 6 inches in thickness. It is very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3). The A2 horizon is 2 to 6 inches thick. It is dark grayish brown (10YR 4/2), brown (10YR 4/3), or grayish brown (10YR 5/2).

The upper part of the B horizon is dark yellowish brown (10YR 4/4) or brown (10YR 4/3) loam. Reaction is medium acid to strongly acid in the upper part of the B2 horizon. If a IIB horizon occurs, it is clay loam, silty clay or clay 2 to 4 inches thick.

Whittier series

The Whittier series consists of well drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils are on high stream benches along rivers and major streams. They formed in 24 to 40 inches of silty material and in the underlying sand and gravel. The slope range is 1 to 4 percent.

Whittier soils are similar to Waukegan soils but have a thinner and generally lighter colored A horizon than do those soils.

Typical pedon in an area of Whittier silt loam, 1 to 4 percent slopes, in a cultivated field 1,700 feet east and 275 feet north of the center sec. 6, T. 85 N., R. 10 W.

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam; brown (10YR 5/3) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

B1—7 to 11 inches; dark yellowish brown (10YR 4/4) light silty clay loam; pale brown (10YR 6/3) silt coatings on peds dry; moderate very fine subangular blocky structure; friable; brown (10YR 4/3) thin discontinuous clay films on ped faces; neutral; clear smooth boundary.

B21t—11 to 21 inches; dark yellowish brown (10YR 4/4) silty clay loam; pale brown (10YR 6/3) silt coatings on peds dry; moderate fine angular blocky and su-

bangular blocky structure; friable; brown (10YR 4/3) thin nearly continuous clay films on ped faces; slightly acid; abrupt smooth boundary.

B22t—21 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; pale brown (10YR 6/3) silt coatings on peds dry; moderate fine and medium angular blocky and subangular blocky structure; friable; brown (10YR 4/3) thin nearly continuous clay films on ped faces; medium acid; abrupt wavy boundary.

IIB23t—27 to 31 inches; dark yellowish brown (10YR 4/4) loam; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; medium acid; clear smooth boundary.

IIC1—31 to 39 inches; yellowish brown (10YR 5/4) loamy sand, single grained; loose; several dark yellowish brown (10YR 4/4) clay discontinuous bands about 1 inch thick; slightly acid; clear wavy boundary.

IIC2—39 to 60 inches; yellowish brown (10YR 5/6) loamy sand with some gravel; single grained; slightly acid.

Solum thickness typically ranges from 30 to 48 inches. It may or may not correspond to the depth to loamy sand or sand. Depth to the sandy material is typically 30 to 40 inches but may be as little as 24 inches.

The A1 or Ap horizon is dark brown (10YR 3/3) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. If an A2 horizon occurs, it is dark grayish brown (10YR 4/2) or brown (10YR 4/3). It typically is about 2 to 5 inches thick, but in eroded areas it may be wholly incorporated into the plow layer.

The B2 horizon has hue of 10YR, value of dominantly 4 or 5, and chroma of 3 or 4. It is silty clay loam with 28 to 33 percent clay. The IIB horizon is loam or sandy loam. Reaction ranges from medium acid to strongly acid in the most acid part.

The C horizon is fine sand or loamy sand.

Wiota series

The Wiota series consists of well drained soils that are moderately permeable in the upper part and rapidly or very rapidly permeable in the lower part. They are on low stream benches. They formed in moderately fine textured alluvium. The slope range is 1 to 3 percent. The Wiota soils in Benton County do not have the argillic horizon that is typical for the Wiota series. This difference does not alter the use or behavior of these soils.

Wiota soils are similar to Nevin and Bremer soils. They have a B horizon that is not so gray as that of those soils. They are also better drained than those soils.

Typical pedon in an area of Wiota silt loam, loamy substratum, 1 to 3 percent slopes, in a cultivated field 1,760 feet south and 635 feet east of the northwest corner sec. 27, T. 82 N., R. 10 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granu-

lar structure; friable; neutral; abrupt smooth boundary.

A12—7 to 12 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—12 to 16 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; very dark grayish brown (10YR 3/2) coatings on some peds; weak very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1t—16 to 22 inches; brown (10YR 4/3) silty clay loam; moderate very fine and fine subangular blocky structure; friable; very thin patchy clay films on peds; few very fine dark oxides; medium acid; clear smooth boundary.

B21t—22 to 31 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; thin nearly continuous clay films on peds; common very fine soft oxides; medium acid; gradual smooth boundary.

B22t—31 to 37 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; friable; thin nearly continuous clay films on peds; pale brown (10YR 6/3) sand and silt coatings on peds dry; few soft oxides; medium acid; clear smooth boundary.

B23t—37 to 47 inches; brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) mottles; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; weak fine prismatic structure parting to moderate fine and very fine subangular blocky; friable; thin patchy clay films on prism and ped faces; pale brown (10YR 6/3) sand and silt coatings on peds dry; slightly acid; abrupt wavy boundary.

C—47 to 60 inches; dark yellowish brown (10YR 4/4) sandy loam; common fine faint dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; massive; very friable; slightly acid.

The solum ranges from 36 to 60 inches in thickness.

The A1 or Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The A horizon is heavy silt loam or light silty clay loam. It is about 14 to 24 inches thick.

The B horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4). It is silty clay loam 20 to 40 inches thick. Reaction is slightly acid or medium acid in the most acid part of the B2 horizon.

The C horizon is brown (10YR 4/4) with grayish brown and yellowish brown mottles. It typically is sandy loam or loamy sand but ranges to stratified loam or silt loam in places.

Zook series

The Zook series consists of poorly drained, slowly permeable soils formed in alluvium on level flood plains along rivers and major streams. The slope range is 0 to 2 percent.

Zook soils are associated with Colo soils. They have a higher clay content throughout the profile than do Colo soils.

Typical pedon in an area of Zook silty clay loam, 0 to 2 percent slopes, in a cultivated area 2,175 feet east and 200 feet north of the southwest corner sec. 29, T. 82 N., R. 12 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate fine granular; firm; neutral; clear boundary.

A12—8 to 14 inches; black (N 2/0) heavy silt clay loam, dark gray (10YR 4/1 dry) moderate very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A13—14 to 26 inches; black (N 2/0) heavy silty clay loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to moderate very fine subangular blocky and granular; firm; neutral; gradual smooth boundary.

A14—26 to 37 inches; black (N 2/0) light silty clay; weak medium prismatic structure parting to moderate very fine subangular blocky and granular; firm; sheen on faces of peds; neutral; gradual smooth boundary.

AC—37 to 45 inches; black (N 2/0) silty clay; weak fine prismatic structure; firm; sheen on faces of peds; neutral; gradual smooth boundary.

C1—45 to 53 inches; black (10YR 2/1) silty clay; weak medium prismatic structure; firm; neutral; gradual smooth boundary.

C2—53 to 60 inches; very dark gray (10YR 3/1) clay loam; few fine faint dark grayish brown (2.5Y 4/2) mottles; massive; common hard dark reddish brown (5YR 2/2) 2 to 3 millimeter oxides; neutral.

Solum thickness ranges from 36 to 60 inches.

The A horizon is black (N 2/0 or 10YR 2/1). It is heavy silty clay loam in the upper part and heavy silty clay loam to silty clay in the lower part. It is 36 to 45 inches thick.

The B horizon, where present, and the C horizon are very dark gray (10YR 3/1), dark gray (10YR to 5Y 4/1), and gray (5Y 5/1). They are heavy silty clay loam, light silty clay, or clay loam.

Formation of the soils

In this section the factors of soil formation are discussed and related to the soils in the survey area. In addition, the influence of man on the soil is discussed.

Factors of soil formation

Soil is produced by the action of soil-forming processes on material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (a) the physical and mineral composition of the parent material, (b) the climate under which the soil has accumulated and existed since accumulation, (c) the plant and animal life on and in the soil, (d) the relief, or lay of the land, and (e) the length of time the forces of soil development have acted on the soil material (2).

Climate and vegetation are the active factors in the formation of soil. They act on the parent material that has accumulated through the weathering of rock and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. Parent material also affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed. It may be much or little, but some time is required for horizon differentiation. A long period generally is required for distinct horizons to develop.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of one unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material and geology

The accumulation of parent material is the first step in the development of a soil. Some soils in Benton County formed as the result of weathering in place of bedrock. Most soils, however, formed in material that was transported from the site of the parent rock and redeposited through the action of glacial ice, water, wind, and gravity.

The principal parent materials in Benton County are glacial drift, loess, alluvium, and eolian, or wind-deposited, sand. Much less extensive parent materials are organic deposits and residuum.

Glacial drift is all rock material transported by glacier ice, all deposits made by glacier ice, and all deposits of dominantly glacial origin made in the sea or in bodies of glacial meltwater. It includes glacial till, which is unsorted sediment made up of particles ranging in size from boulders to clay (7).

At least twice during the glacial period, continental ice or glaciers moved over Benton County. The record of these invasions is contained in the unconsolidated rock material deposited by the melting ice and by meltwater streams. The older ice sheet, known as the Nebraskan, occurred some 750,000 years ago (3). It was followed by the Aftonian interglacial period. The Kansan glaciation is thought to have started about 500,000 years ago.

A more recent glaciation was recognized by Leighton (4) as the lowan substage of the Wisconsin glaciation, but recent studies indicate that conclusions formed from

studies made before 1960 are questionable. Intensive, detailed geomorphic stratigraphic work shows that the landscape is a multilevel sequence of erosion surfaces and that many of the levels are cut into Kansan and Nebraskan till. Ruhe's study in Tama and Linn Counties (9) demonstrated that lowan till does not exist, but that an erosion surface complex does exist in the lowan region. The multilevel lowan surface is a series of steps from major drainageways toward bounding divides. It is marked by a stone line where it cuts Kansan and Nebraskan till. The stone line occurs on all levels of the stepped surfaces and passes under the alluvium along drainageways.

Soils formed in glacial drift on the lowan erosion surface are the Bassett, Clyde, Coggon, Donnan, Floyd, Kenyon, Readlyn, Schley, and Tripoli soils. In these soils a loamy surficial sediment about 1 to 2 feet thick overlies the glacial material. This sediment is deeper, however, in such soils as the Clyde, Floyd, and Schley soils on lower concave slopes and in waterways. A stone line or pebble band commonly separates the friable loamy surficial sediment from the firm loam or clay loam glacial till. Donnan soils formed in loamy material and in the clayey paleosol derived from glacial till.

Loess is windblown silt. It forms a mantle of variable thickness over the glacial drift in much of the upland. In general the loess is thickest along the southern boundary of the county. Very little loess is in the northeastern corner of the county. Where the loess is more than 40 inches thick, the Tama, Downs, or Fayette soils formed. Where the loess is 20 to 40 inches thick over glacial till, Dinsdale, Klinger, Maxfield, or Waubeek soils formed. The elongated, loess-capped ridges oriented northwesterly to southeasterly and are called pahas (10, 11). They stand apart on the lowan plain or merge with similar features to form lengthy ridges or broad plateaus.

Alluvium is sediment transported and deposited by water. Alluvial deposits of Late Wisconsin age occur under the flood plains and terraces of watercourses in Benton County as lenses and layers of sand, gravel, silt, and clay. Along major streams alluvial material is as much as 95 feet thick; along small streams it is less than 5 feet thick. Waukegan soils formed in loamy alluvium over sand and gravel. The Waukegan soils formed in silty alluvium over sand and gravel.

Some alluvial material, which was transported only a short distance, accumulated at the foot of the slope on which it originated. This material is called "local" alluvium and retains many characteristics of the soils in the area from which it eroded. The Ely soil is an example. It occurs at the foot of slopes, directly below loess-derived soils.

When streams overflow their channels and water spreads over the flood plain, coarse-textured material is deposited first. Fine-textured sediment, such as silt, is deposited by more slowly moving water. After the flood has passed, the finest particles, or clay, settle from the water left standing in the lowest part of the flood plain.

Spillville soils formed in loamy material. Nodaway soils formed in finer textured silty material. Colo soils, which are on the lowest part of the flood plain, contain more clay and typically are silty clay loam throughout.

Eolian sand or wind-deposited sand occurs in uplands and on benches. In glacial till uplands, sand occurs as low mounds or dunes underlain by till at various depths. Sand also occurs in areas intermingled with areas of loess soils. Wind-deposited sand consists largely of quartz which is very fine and fine in size and is highly resistant to weathering. It has not been altered appreciably since it was deposited. Soils that formed mainly in wind-deposited sand are Dickinson, Lamont, and Sparta soils.

Organic deposits occur in old lakebeds or swamps that supported a thick growth of water-tolerant plants. Poor drainage retarded the decay of the plant remains, which accumulated over a period of time. The organic material ranges from about 10 to 60 inches in thickness and in a few areas it is more than 60 inches thick. Palms soils formed in organic material.

Residuum is the material derived from the weathering in places of sedimentary rock or of the material just over sedimentary rock. It is a very minor parent material in Benton County. The underlying bedrock belongs to the Devonian and Pennsylvanian systems. Strata of sandstone, limestone, dolomite, and shale are stacked in layer-cake fashion. The Upper and Middle Devonian series crops out or underlies the glacial till in most of the county. The Pennsylvanian system underlies the glacial till in an area of the southern part of the county.

Climate

The morphology of most of the soils indicates that the climate under which they formed was similar to the present one. At present, the climate is fairly uniform throughout the county. It is marked by wide seasonal extremes in temperature. Precipitation is distributed throughout the year. According to available evidence, the soils of Benton County have developed under this midcontinental, subhumid climate for at least 3,000 years. Between 5,000 and 16,000 years ago, the climate was conducive to the growth of forest vegetation (6).

Temperature, rainfall, relative humidity, and length of frost-free period are important in determining the vegetation. Climate is also a major factor in determining the kinds of soils that develop from plant materials because the rate and intensity of hydrolysis, carbonation, oxidation, and other important chemical reactions in the soil are influenced by climate.

The influence of the general climate of the region is somewhat modified by local conditions in or near the developing soil. For example, south-facing, dry, sandy slopes have a local climate or microclimate that is warmer and less humid than the climate of nearby areas. Low-lying, poorly drained areas are wetter and colder than most areas around them. These contrasts account

for some of the differences in soils within the same general climatic region.

Plant and animal life

All living organisms—plants, animals, bacteria, and fungi—influence soil formation. Plants are responsible for the content of organic matter and nutrients and the color of the surface layer. Animals such as earthworms and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients for plant food.

Most of the soils in Benton County developed under prairie grasses or a mixture of prairie grasses and water-tolerant plants. Because the grasses have many roots and tops that have decayed on or in the soil, the soils have a thick, dark surface layer. Kenyon and Floyd soils are examples.

The soils which developed under timber vegetation have a thinner, lighter surface layer. Organic matter, principally from leaves, was deposited only on the surface of the soil. Fayette and Coggon soils are examples.

In many areas soils developed for a time under prairie grasses and then under forest vegetation. These soils are intermediate between soils formed entirely under grass and those formed entirely under forest. Downs and Waubeek soils are examples.

The Tama, Downs, and Fayette soils are members of a group of soils that formed from the same kind of parent material under comparable environment except for native vegetation. Differences in native vegetation account for the main differences in morphology of soils of this group.

Relief

Relief, or topography, influences soil development mainly through its effect on drainage, runoff, and erosion. In Benton County the relief ranges from level to very steep.

Water soaks into nearly level areas that are not flooded. On steeper slopes, more water runs off and less penetrates the soil. The Dinsdale, Klinger, and Maxfield soils all formed in the same kind of parent material under similar vegetation but differ because of topographic position. Maxfield soils are on broad, level or nearly level, high upland flats. Klinger soils are on nearly level ridges and long, gentle, concave slopes. Dinsdale soils are on gently sloping to moderately sloping uplands.

In depressions which collect and impound water for a period of time, the soils are poorly drained and have a distinct, lighter colored subsurface layer and a gray subsoil. Walford soils formed in depressions.

Soils on steep slopes have weak soil development. Most of the water that falls on their surface runs off. Sogn soils are an example.

Soils that formed in alluvium on bottom lands, such as Colo and Spillville soils, are nearly level. Their microrelief, however, affects runoff, depth to water table, and

amount of new sediment. Colo soils, which are on low elevations, have a high water table and impound water for short periods of time. Spillville soils, on slightly higher elevations are moderately well drained.

Aspect as well as gradient influences soil development. South-facing slopes generally are warmer and drier than north-facing slopes and consequently support a different kind and amount of vegetation.

The influence of a porous, rapidly permeable parent material may override the influence of topography. Dickinson soils, for example, are somewhat excessively drained even though they are nearly level to strongly sloping, because they are moderately rapid to rapidly permeable.

Time

The length of time that the soil material remains in place and is acted on by the soil-forming processes affects the kind of soil that develops. Older or strongly developed soils show well defined genetic horizons. The Tama, Downs, and Fayette soils are examples. A younger soil shows only weakly developed horizons. Some soils that formed in alluvium show little or no profile development because fresh material is deposited periodically. The material has not been in place long enough for well defined genetic horizons to develop under the influence of the climate and vegetation. Nodaway soils are an example. Soils on steep slopes show little or no development because soil material is removed before it has time to develop into a deep profile. Sogn soils are an example.

The resistance of materials may modify the effect of time. Soils that formed in material resistant to weathering, such as quartz sand, do not change much with time. Examples are Chelsea and Sparta soils.

Where organic material, such as wood, has been buried by deposition through the action of ice, water, or wind, the age of a landscape can be determined by a process known as radiocarbon dating (8).

The loess in Benton County, from which Tama, Downs, and Fayette soils formed, is probably 14,000 to 20,000 years old. Recent studies by Ruhe and others (9) show that the lowan erosion surface formed during loess deposition time. The lowan surface beneath the loess could be as young as 14,000 years, which dates the close of the major loess deposition in Iowa. The surface not covered by loess can be younger than the loess. The lowan surface where covered by loam surficial sediment is younger than 14,000 years, and soils on the slopes are probably much younger. Soils such as the Bassett, Kenyon, Aredale, Readlyn, and Tripoli soils are on this surface. The Floyd, Clyde, and Schley soils are younger, as they are cut in and below these higher-lying soils.

The influence of man

Important changes occurred when man settled Benton County and began to cultivate the soils. Some had little effect on soil productivity, and others had drastic effects.

Water erosion caused the most obvious changes. Cultivation makes sloping areas more susceptible to erosion, which removes topsoil, organic matter, and plant nutrients. Sheet erosion, which is the most prevalent in the county, removes a few inches of topsoil at a time, but in deep soils cultivation usually destroys all evidence of this loss. In places, shallow and deep gullies have formed, and the eroded material has been deposited on the lower slopes.

Wind erosion also occurs when man cultivates the soil. Coarse textured soils blow, especially when the land is left bare and the topsoil is dry. On nearly level fields that have been fallplowed, dark topsoil can be seen mixed with the snow or piled along fence rows and road ditches.

The well developed granular structure of the surface layer, apparent in virgin grassland, begins to break down in fields that are continuously cultivated. The surface soil tends to bake and become hard when dry. Fine-textured soils that have been plowed continuously when wet tend to puddle and are less permeable than similar soils in undisturbed areas. In some fields of fine-textured soils, a compact layer which is hard when dry and is less permeable than the subsoil has formed below the plowed layer. This layer is called a "plowsole", or "plowpan."

In many places, dark-colored, low-lying soils have received lighter colored deposits. Nodaway silt loam is a soil formed in recent alluvium that shows the influence of man. It has strata of light and dark colored material washed from the hillsides and deposited by floods. This erosion has taken place since man began cultivating the hillsides.

Man has also done much to increase productivity and to reclaim areas not suitable for crops. He has established drainage ditches and diversions at the foot of slopes to prevent flooding of the lowlands, which can now be cultivated. He has also added commercial fertilizers to counteract deficiencies in plant nutrients so that the soil can be more productive than virgin soil.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low.....	0 to 3
Low.....	3 to 6
Moderate.....	6 to 9
High.....	9 to 12
Very high.....	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse textured soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. Preparing a seedbed with a minimum of soil disturbance and leaving the needed amount of crop residue on the surface to protect the soil.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock. Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless

the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as pro-

tection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus; or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A

soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Paha. A loess-capped prominence, elliptical in shape, surrounded by soils that formed in glacial till.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables.) The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow.....	less than 0.06 inch
Slow.....	0.06 to 0.20 inch
Moderately slow.....	0.2 to 0.6 inch
Moderate.....	0.6 inch to 2.0 inches
Moderately rapid.....	2.0 to 6.0 inches
Rapid.....	6.0 to 20 inches
Very rapid.....	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid.....	Below 4.5
Very strongly acid.....	4.5 to 5.0
Strongly acid.....	5.1 to 5.5
Medium acid.....	5.6 to 6.0
Slightly acid.....	6.1 to 6.5
Neutral.....	6.6 to 7.3
Mildly alkaline.....	7.4 to 7.8
Moderately alkaline.....	7.9 to 8.4
Strongly alkaline.....	8.5 to 9.0
Very strongly alkaline.....	9.1 and higher

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in di-

ameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millime- ters
Very coarse sand.....	2.0 to 1.0
Coarse sand.....	1.0 to 0.5
Medium sand.....	0.5 to 0.25
Fine sand.....	0.25 to 0.10
Very fine sand.....	0.10 to 0.05
Silt.....	0.05 to 0.002
Clay.....	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer

than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A

terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt*, *silt loam*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress road-banks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature ¹						Precipitation ¹				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have--		Average number of growing degree days ²	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
<u>of</u>	<u>of</u>	<u>of</u>	<u>of</u>	<u>of</u>	<u>Units</u>	<u>In</u>	<u>In</u>	<u>In</u>	<u>In</u>		
January----	27.5	8.9	18.3	52	-24	0	.99	.33	1.51	2	6.6
February---	33.5	15.3	24.1	57	-19	0	.94	.33	1.42	3	7.2
March-----	43.8	24.6	34.2	76	-6	24	2.19	1.15	3.03	5	7.7
April-----	60.9	38.0	49.5	87	18	91	3.49	2.17	4.67	7	.9
May-----	72.5	48.8	60.7	90	30	342	4.45	2.58	5.96	8	.0
June-----	81.8	58.5	70.2	96	42	606	3.88	2.10	5.32	7	.0
July-----	85.5	62.2	73.9	98	46	741	3.97	2.27	5.35	6	.0
August-----	83.6	60.1	71.9	97	44	679	3.67	1.85	5.14	6	.0
September--	75.6	51.2	63.4	94	31	402	3.64	1.48	5.38	6	.0
October----	65.4	41.1	53.3	87	19	186	2.18	.58	3.45	5	.0
November---	47.2	28.0	37.6	71	3	8	1.63	.57	2.47	3	2.1
December---	33.0	16.3	24.7	59	-18	0	1.35	.74	1.85	3	7.6
Year-----	59.2	37.8	48.5	99	-24	3,079	32.38	27.02	37.49	61	32.1

¹Recorded in the period 1951-74 at Vinton, Iowa.

²A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature ¹		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 20	April 27	May 14
2 years in 10 later than--	April 15	April 23	May 9
5 years in 10 later than--	April 7	April 15	April 30
First freezing temperature in fall:			
1 year in 10 earlier than--	October 13	October 2	September 20
2 years in 10 earlier than--	October 18	October 8	September 25
5 years in 10 earlier than--	October 27	October 18	October 5

¹Recorded in the period 1951-74
at Vinton, Iowa.

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season ¹		
	Higher than 24° F Days	Higher than 28° F Days	Higher than 32° F Days
9 years in 10	185	165	140
8 years in 10	191	172	146
5 years in 10	202	185	158
2 years in 10	214	199	170
1 year in 10	220	206	176

¹Recorded in the period 1951-74
at Vinton, Iowa.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
11B	Colo-Ely complex, 2 to 5 percent slopes-----	50,960	11.1
41	Sparta loamy fine sand, 0 to 2 percent slopes-----	700	0.2
41B	Sparta loamy fine sand, 2 to 5 percent slopes-----	2,480	0.5
41C	Sparta loamy fine sand, 5 to 9 percent slopes-----	2,185	0.5
41D	Sparta loamy fine sand, 9 to 14 percent slopes-----	440	0.1
51	Vesser silt loam, 0 to 2 percent slopes-----	555	0.1
54	Zook silty clay loam, 0 to 2 percent slopes-----	1,130	0.2
63B	Chelsea loamy fine sand, 1 to 5 percent slopes-----	990	0.2
63C	Chelsea loamy fine sand, 5 to 9 percent slopes-----	1,030	0.2
63D	Chelsea loamy fine sand, 9 to 18 percent slopes-----	1,870	0.4
63F	Chelsea loamy fine sand, 18 to 25 percent slopes-----	365	0.1
65E2	Lindley loam, 14 to 18 percent slopes, moderately eroded-----	800	0.2
65F	Lindley loam, 18 to 25 percent slopes-----	450	0.1
65F3	Lindley clay loam, 18 to 25 percent slopes, severely eroded-----	240	0.1
83B	Kenyon loam, 2 to 5 percent slopes-----	14,280	3.1
83C	Kenyon loam, 5 to 9 percent slopes-----	10,400	2.3
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded-----	15,555	3.4
83D	Kenyon loam, 9 to 14 percent slopes-----	450	0.1
83D2	Kenyon loam, 9 to 14 percent slopes, moderately eroded-----	2,970	0.6
84	Clyde silty clay loam, 0 to 2 percent slopes-----	2,010	0.4
109C	Backbone fine sandy loam, 4 to 12 percent slopes-----	395	0.1
110B	Lamont fine sandy loam, 2 to 5 percent slopes-----	1,310	0.3
110C	Lamont fine sandy loam, 5 to 9 percent slopes-----	690	0.2
118	Garwin silty clay loam, 0 to 2 percent slopes-----	5,375	1.2
119	Muscataine silty clay loam, 0 to 2 percent slopes-----	10,575	2.3
119B	Muscataine silty clay loam, 2 to 5 percent slopes-----	11,825	2.6
120	Tama silty clay loam, 0 to 2 percent slopes-----	480	0.1
120B	Tama silty clay loam, 2 to 5 percent slopes-----	20,045	4.4
120C	Tama silty clay loam, 5 to 9 percent slopes-----	1,765	0.4
120C2	Tama silty clay loam, 5 to 9 percent slopes, moderately eroded-----	2,060	0.4
122	Sperry silt loam, 0 to 1 percent slopes-----	170	#
127	Wiota silt loam, loamy substratum, 1 to 3 percent slopes-----	1,660	0.4
133	Colo silty clay loam, 0 to 2 percent slopes-----	21,835	4.8
159	Finchford loamy sand, 0 to 2 percent slopes-----	945	0.2
162B	Downs silt loam, 2 to 5 percent slopes-----	1,155	0.3
162C	Downs silt loam, 5 to 9 percent slopes-----	1,425	0.3
162C2	Downs silt loam, 5 to 9 percent slopes, moderately eroded-----	2,430	0.5
162D	Downs silt loam, 9 to 14 percent slopes-----	670	0.1
162D2	Downs silt loam, 9 to 14 percent slopes, moderately eroded-----	755	0.2
163B	Fayette silt loam, 2 to 5 percent slopes-----	1,450	0.3
163C	Fayette silt loam, 5 to 9 percent slopes-----	6,450	1.4
163C2	Fayette silt loam, 5 to 9 percent slopes, moderately eroded-----	4,960	1.1
163D	Fayette silt loam, 9 to 14 percent slopes-----	5,260	1.1
163D2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded-----	5,470	1.2
163E	Fayette silt loam, 14 to 18 percent slopes-----	4,320	0.9
163E2	Fayette silt loam, 14 to 18 percent slopes, moderately eroded-----	5,710	1.2
163F	Fayette silt loam, 18 to 25 percent slopes-----	5,740	1.2
163F2	Fayette silt loam, 18 to 25 percent slopes, moderately eroded-----	3,355	0.7
163G	Fayette silt loam, 25 to 40 percent slopes-----	2,230	0.5
171B	Bassett loam, 2 to 5 percent slopes-----	945	0.2
171C	Bassett loam, 5 to 9 percent slopes-----	580	0.1
171C2	Bassett loam, 5 to 9 percent slopes, moderately eroded-----	1,540	0.3
171D	Bassett loam, 9 to 14 percent slopes-----	485	0.1
171D2	Bassett loam, 9 to 14 percent slopes, moderately eroded-----	1,590	0.3
175	Dickinson fine sandy loam, 0 to 2 percent slopes-----	355	0.1
175B	Dickinson fine sandy loam, 2 to 5 percent slopes-----	4,980	1.1
175C	Dickinson fine sandy loam, 5 to 9 percent slopes-----	1,865	0.4
177	Saude loam, 0 to 2 percent slopes-----	470	0.1
177B	Saude loam, 2 to 5 percent slopes-----	810	0.2
177C	Saude loam, 5 to 9 percent slopes-----	635	0.1
178	Waukee loam, 0 to 2 percent slopes-----	1,400	0.3
178B	Waukee loam, 2 to 5 percent slopes-----	2,135	0.5
184B	Klinger silty clay loam, 1 to 4 percent slopes-----	1,560	0.3
198B	Floyd loam, 1 to 4 percent slopes-----	2,060	0.4
207C	Whalan loam, 20 to 30 inches to limestone, 2 to 9 percent slopes-----	255	0.1
214C	Rockton loam, 20 to 30 inches to limestone, 2 to 9 percent slopes-----	345	0.1
220	Nodaway silt loam, 0 to 2 percent slopes-----	3,290	0.7
221B	Palms muck, 1 to 4 percent slopes-----	150	#
226	Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes-----	2,110	0.5
284	Flagler sandy loam, 0 to 2 percent slopes-----	1,075	0.2

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
284B	Flagler sandy loam, 2 to 5 percent slopes-----	600	0.1
285C	Burkhardt sandy loam, 2 to 9 percent slopes-----	405	0.1
291	Atterberry silt loam, 1 to 3 percent slopes-----	655	0.1
293C	Chelsea-Lamont-Fayette complex, 5 to 9 percent slopes-----	1,970	0.4
293D	Chelsea-Lamont-Fayette complex, 9 to 18 percent slopes-----	4,490	1.0
293F	Chelsea-Lamont-Fayette complex, 18 to 30 percent slopes-----	2,115	0.5
302B	Coggon loam, 2 to 5 percent slopes-----	270	0.1
302C	Coggon loam, 5 to 9 percent slopes-----	425	0.1
302C2	Coggon loam, 5 to 9 percent slopes, moderately eroded-----	240	0.1
315	Fluvaquents, sandy and loamy-----	6,180	1.3
350	Waukegan silt loam, 0 to 2 percent slopes-----	2,820	0.6
350B	Waukegan silt loam, 2 to 5 percent slopes-----	1,495	0.3
352B	Whittier silt loam, 1 to 4 percent slopes-----	515	0.1
377B	Dinsdale silty clay loam, 2 to 5 percent slopes-----	69,465	15.2
377C	Dinsdale silty clay loam, 5 to 9 percent slopes-----	28,705	6.2
377C2	Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded-----	8,265	1.8
382	Maxfield silty clay loam, 0 to 2 percent slopes-----	280	0.1
391B	Clyde-Floyd complex, 1 to 4 percent slopes-----	10,550	2.3
398	Tripoli clay loam, 0 to 2 percent slopes-----	285	0.1
399	Readlyn loam, 1 to 3 percent slopes-----	1,985	0.4
407B	Schley loam, 1 to 4 percent slopes-----	1,445	0.3
408B	Olin fine sandy loam, 2 to 5 percent slopes-----	4,390	1.0
408C	Olin fine sandy loam, 5 to 9 percent slopes-----	1,200	0.3
412C	Sogn loam, 5 to 9 percent slopes-----	380	0.1
412D	Sogn loam, 9 to 18 percent slopes-----	515	0.1
412F	Sogn loam, 18 to 40 percent slopes-----	650	0.1
420	Tama silty clay loam, benches, 0 to 2 percent slopes-----	2,650	0.6
420B	Tama silty clay loam, benches, 2 to 5 percent slopes-----	810	0.2
426B	Aredale loam, 2 to 5 percent slopes-----	4,565	1.0
426C	Aredale loam, 5 to 9 percent slopes-----	1,450	0.3
428B	Ely silt loam, 2 to 5 percent slopes-----	4,785	1.0
485	Spillville loam, 0 to 2 percent slopes-----	1,495	0.3
536	Hanlon fine sandy loam, 0 to 2 percent slopes-----	360	0.1
727	Udolpho loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes-----	605	0.1
729B	Nodaway-Radford silt loams, 2 to 5 percent slopes-----	3,215	0.7
771B	Waubeeek silt loam, 2 to 5 percent slopes-----	2,355	0.5
771C	Waubeeek silt loam, 5 to 9 percent slopes-----	710	0.2
771C2	Waubeeek silt loam, 5 to 9 percent slopes, moderately eroded-----	880	0.2
778	Sattre loam, 0 to 2 percent slopes-----	320	0.1
778B	Sattre loam, 2 to 5 percent slopes-----	395	0.1
782B	Donnan silt loam, 2 to 5 percent slopes-----	200	*
782C2	Donnan silt loam, 5 to 9 percent slopes, moderately eroded-----	540	0.1
1043	Bremer silty clay loam, sandy substratum, 0 to 2 percent slopes-----	1,625	0.4
1088	Nevin silty clay loam, sandy substratum, 0 to 2 percent slopes-----	1,840	0.4
1119	Muscataine silty clay loam, benches, 0 to 2 percent slopes-----	2,700	0.6
1133	Colo silty clay loam, channeled, 0 to 2 percent slopes-----	1,045	0.2
1160	Walford silt loam, sandy substratum, 0 to 1 percent slopes-----	1,115	0.2
1291	Atterberry silt loam, benches, 0 to 2 percent slopes-----	780	0.2
1485	Spillville loam, channeled, 0 to 2 percent slopes-----	1,325	0.3
1688	Koszta silt loam, loamy substratum, 0 to 2 percent slopes-----	960	0.2
5030	Pits, quarries-----	240	0.1
5040	Orthents, loamy-----	155	*
	Water-----	3,100	0.7
	Total-----	459,520	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Oats	Grass- legume hay	Smooth brome grass	Brome grass- alfalfa	Kentucky bluegrass
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>	<u>AUM*</u>	<u>AUM*</u>
11B----- Colo-Ely	112	43	84	4.6	6.3	7.7	4.1
41----- Sparta	55	---	50	2.5	4.3	4.3	2.0
41B----- Sparta	50	---	40	2.5	4.3	4.3	2.0
41C, 41D----- Sparta	---	---	---	---	3.6	3.6	2.0
51----- Vesser	95	36	52	4.0	5.0	5.6	3.7
54----- Zook	96	36	72	4.0	4.0	7.0	4.0
63B----- Chelsea	57	21	42	2.0	3.3	3.3	2.0
63C----- Chelsea	52	20	39	1.8	3.0	3.0	1.8
63D----- Chelsea	---	---	35	1.5	2.5	2.5	1.5
63F----- Chelsea	---	---	---	1.0	1.6	1.6	1.0
65E2----- Lindley	---	---	---	1.5	3.0	3.6	2.0
65F, 65F3----- Lindley	---	---	---	---	2.0	3.0	1.6
83B----- Kenyon	113	43	90	4.7	6.6	7.8	4.2
83C----- Kenyon	108	41	86	4.5	6.5	7.5	4.0
83C2----- Kenyon	105	40	84	4.4	6.3	7.3	3.8
83D----- Kenyon	99	38	80	4.2	5.8	7.0	3.7
83D2----- Kenyon	96	36	76	4.0	5.6	6.6	3.4
84----- Clyde	102	39	82	4.0	5.5	6.6	6.6
109C----- Backbone	50	19	35	2.1	3.0	3.5	2.0
110B----- Lamont	69	26	52	2.5	3.5	4.1	2.3
110C----- Lamont	64	24	48	2.3	3.3	3.8	2.1

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass- legume hay	Smooth brome grass	Brome grass- alfalfa	Kentucky bluegrass
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>	<u>AUM*</u>	<u>AUM*</u>
118----- Garwin	125	47	94	5.0	7.5	8.3	4.1
119----- Muscatine	131	50	98	5.5	7.8	9.1	4.2
119B----- Muscatine	129	49	96	5.5	7.6	9.1	4.2
120----- Tama	127	49	95	5.3	7.6	8.6	4.2
120B----- Tama	125	48	95	5.2	7.5	8.6	4.2
120C----- Tama	120	46	90	5.0	7.1	8.3	4.0
120C2----- Tama	117	44	88	4.9	7.0	8.1	3.8
122----- Sperry	97	37	53	3.5	5.1	7.0	3.6
127----- Wlota	118	45	89	5.0	7.0	8.3	4.0
133----- Colo	104	40	78	4.2	5.5	7.0	4.2
159----- Finchford	45	15	35	1.5	2.0	2.5	1.5
162B----- Downs	119	45	95	5.0	6.8	8.3	4.1
162C----- Downs	114	43	91	4.8	6.6	8.1	4.0
162C2----- Downs	111	42	89	4.7	6.1	7.8	3.8
162D----- Downs	105	40	84	4.4	6.1	7.3	3.8
162D2----- Downs	102	39	82	4.3	6.0	7.1	3.6
163B----- Fayette	113	43	90	4.7	6.6	7.8	4.0
163C----- Fayette	108	41	86	4.5	6.5	7.5	3.8
163C2----- Fayette	105	40	84	4.4	6.2	7.2	3.6
163D----- Fayette	99	38	80	4.2	6.0	7.0	3.6
163D2----- Fayette	96	36	76	4.0	5.6	6.6	3.5
163E----- Fayette	84	32	67	3.5	5.0	5.8	3.3
163E2----- Fayette	81	31	65	3.4	4.9	5.6	3.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass- legume hay	Smooth brome grass	Brome grass- alfalfa	Kentucky bluegrass
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>	<u>AUM*</u>	<u>AUM*</u>
163F----- Fayette	---	---	60	3.4	4.8	5.6	3.1
163F2----- Fayette	---	---	55	3.2	4.4	5.2	3.0
163G----- Fayette	---	---	---	3.0	4.2	5.0	3.0
171B----- Bassett	107	40	85	4.5	6.5	7.5	4.0
171C----- Bassett	102	39	81	4.3	6.1	7.1	4.0
171C2----- Bassett	99	38	80	4.0	6.0	6.6	3.5
171D----- Bassett	93	35	74	4.0	5.6	6.6	3.5
171D2----- Bassett	90	34	72	3.8	5.3	6.3	3.2
175----- Dickinson	83	32	62	3.0	5.0	5.0	2.7
175B----- Dickinson	81	31	60	3.0	4.8	5.0	2.7
175C----- Dickinson	76	29	57	2.8	4.5	4.6	2.5
177----- Saude	78	30	62	3.3	4.6	5.5	3.0
177B----- Saude	76	29	61	3.2	4.5	5.3	3.0
177C----- Saude	71	27	57	3.0	4.3	5.0	2.8
178----- Waukee	98	37	78	4.1	5.8	6.8	4.0
178B----- Waukee	96	36	77	4.0	5.6	6.6	4.0
184B----- Klinger	123	46	92	5.1	7.3	8.5	4.2
198B----- Floyd	106	40	85	4.5	6.9	7.5	4.1
207C----- Whalan	59	22	47	2.5	4.0	4.1	2.1
214C----- Rockton	71	27	57	2.8	4.3	4.6	2.5
220----- Nodaway	110	42	60	4.6	5.5	4.0	4.0
221B----- Palms	75	29	61	3.0	4.6	5.0	3.1
226----- Lawler	100	38	80	4.2	6.0	7.0	4.0
284----- Flagler	72	27	58	3.0	4.3	5.0	2.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass- legume hay	Smooth brome grass	Brome grass- alfalfa	Kentucky blue grass
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>	<u>AUM*</u>	<u>AUM*</u>
284B----- Flagler	70	26	56	2.9	4.1	4.8	2.1
285C----- Burkhardt	36	14	29	1.2	1.5	2.0	1.0
291----- Atterberry	125	47	93	5.0	6.9	8.3	4.0
293C----- Chelsea-Lamont-Fayette	68	26	52	2.6	3.8	4.3	2.3
293D----- Chelsea-Lamont-Fayette	---	---	47	2.2	3.2	3.6	2.1
293F----- Chelsea-Lamont-Fayette	---	---	---	1.4	2.2	2.4	1.5
302B----- Coggon	101	38	80	4.3	5.0	7.1	3.8
302C----- Coggon	96	36	77	4.0	5.6	6.6	3.6
302C2----- Coggon	93	35	74	3.8	5.5	6.3	3.5
315**. Fluvaquents							
350----- Waukegan	89	35	71	4.0	5.0	5.6	3.3
350B----- Waukegan	87	30	70	4.0	5.0	5.6	3.3
352B----- Whittier	83	31	67	3.5	5.0	5.8	3.3
377B----- Dinsdale	119	45	89	5.0	7.1	8.3	4.1
377C----- Dinsdale	114	43	85	4.8	6.8	8.0	4.0
377C2----- Dinsdale	111	42	83	4.6	6.6	7.6	3.8
382----- Maxfield	119	45	89	5.0	6.6	8.3	4.2
391B----- Clyde-Floyd	103	39	83	4.2	6.1	7.0	5.6
398----- Tripoli	111	42	89	4.5	6.5	7.5	4.1
399----- Readlyn	113	43	90	4.7	6.8	7.8	4.1
407B----- Schley	100	38	80	4.2	6.0	7.0	4.0
408B----- Olin	97	37	73	4.1	5.8	6.8	3.0
408C----- Olin	92	35	70	3.9	5.5	6.5	2.8

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass- legume hay	Smooth brome grass	Brome grass- alfalfa	Kentucky bluegrass
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>	<u>AUM*</u>	<u>AUM*</u>
412C----- Sogn	41	16	33	1.8	2.1	3.0	1.6
412D, 412F----- Sogn	---	---	---	1.2	1.6	2.0	1.0
420----- Tama	127	49	95	5.3	7.6	8.6	4.2
420B----- Tama	125	48	95	5.2	7.5	8.6	4.2
426B----- Aredale	113	43	90	4.7	6.8	7.8	4.2
426C----- Aredale	108	41	86	4.5	6.5	7.5	4.0
428B----- Ely	124	47	93	5.3	7.5	8.8	4.0
485----- Spillville	122	46	98	5.1	7.3	8.6	4.2
536----- Hanlon	90	34	72	3.8	5.3	6.3	3.3
727----- Udolpho	80	27	70	3.5	6.9	5.0	4.0
729B----- Nodaway-Radford	95	36	76	4.0	5.4	6.6	3.6
771B----- Waubeeek	113	43	85	4.7	6.8	7.8	4.0
771C----- Waubeeek	108	41	81	4.5	6.5	7.5	3.8
771C2----- Waubeeek	105	40	79	4.4	6.3	7.3	3.7
778----- Sattre	93	35	75	3.9	5.5	6.5	3.7
778B----- Sattre	91	34	73	3.8	5.3	6.3	3.5
782B----- Donnan	70	24	56	2.8	3.5	4.6	2.7
782C2----- Donnan	60	22	48	2.4	2.9	4.0	2.3
1043----- Bremer	110	42	83	4.6	6.5	7.6	4.0
1088----- Nevin	118	46	90	5.0	7.0	8.3	4.0
1119----- Muscatine	131	50	98	5.5	7.8	9.1	4.2
1133----- Colo	---	---	---	---	---	---	3.0
1160----- Walford	100	38	75	3.5	5.0	5.8	3.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass- legume hay	Smooth brome grass	Brome grass- alfalfa	Kentucky bluegrass
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>	<u>AUM*</u>	<u>AUM*</u>
1291----- Atterberry	125	45	93	5.0	7.0	8.3	4.0
1485----- Spillville	---	---	---	---	---	---	3.8
1688----- Koszta	108	41	81	4.5	6.5	---	3.7
5030**, Pits							
5040**, Orthents							

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
11B*: Colo-----	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash-----	Silver maple, eastern cottonwood.
Ely-----	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
41, 41B, 41C, 41D-Sparta	European privet	Autumn-olive-----	Austrian pine, tall purple willow.	Eastern white pine, red pine.	---
51----- Vesser	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
54----- Zook	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Northern white-cedar, laurel willow, Amur maple.	Green ash-----	Silver maple, eastern cottonwood.
63B, 63C, 63D----- Chelsea	Siberian peashrub, gray dogwood.	Eastern redcedar, Russian-olive, Siberian crabapple, nannyberry viburnum.	Common hackberry, eastern white pine, red pine.	---	---
63F. Chelsea					
65E2, 65F, 65F3--- Lindley	---	Amur honeysuckle, autumn-olive, American cranberrybush.	Eastern redcedar	---	---
83B, 83C, 83C2, 83D, 83D2----- Kenyon	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
84----- Clyde	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
109C----- Backbone	Siberian peashrub, gray dogwood.	Russian-olive, eastern redcedar.	Nannyberry viburnum, common hackberry.	---	---
110B, 110C----- Lamont	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
118----- Garwin	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
119, 119B----- Muscatine	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
120, 120B, 120C, 120C2----- Tama	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
122----- Sperry	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
127----- Wiota	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry, silver maple.	Eastern cottonwood.
133----- Colo	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash-----	Silver maple, eastern cottonwood.
159----- Finchford	Siberian peashrub, gray dogwood.	Russian-olive, eastern redcedar.	Common hackberry, nannyberry viburnum.	---	---
162B, 162C, 162C2, 162D, 162D2----- Downs	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
163B, 163C, 163C2, 163D, 163D2, 163E, 163E2----- Fayette	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
163F, 163F2, 163G Fayette	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Eastern cottonwood, silver maple.	---
171B, 171C, 171C2, 171D, 171D2----- Bassett	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
175, 175B, 175C--- Dickinson	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
177, 177B, 177C--- Saude	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
178, 178B----- Waukee	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
184B----- Klinger	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
198B----- Floyd	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
207C----- Whalan	---	Siberian crabapple, gray dogwood, Tatarian honeysuckle, lilac.	Eastern redcedar, eastern white pine, white spruce, red pine, common hackberry.	Green ash-----	Eastern cottonwood.

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
214C----- Rockton	---	Siberian crabapple, gray dogwood, Tatarian honeysuckle, lilac.	Eastern redcedar, northern white-cedar, blue spruce, eastern white pine, common hackberry.	Green ash-----	---
220----- Nodaway	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
221B----- Palms	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Eastern cottonwood.
226----- Lawler	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
284, 284B----- Flagler	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
285C----- Burkhardt	---	Siberian peashrub, lilac, eastern redcedar, Russian-olive, Siberian crabapple, silver buffaloberry.	Norway spruce, common hackberry.	Eastern white pine, red pine.	
291----- Atterberry	Gray dogwood-----	Autumn-olive-----	Russian-olive-----	Norway spruce-----	Silver maple.
293C*, 293D*: Chelsea-----	Siberian peashrub, gray dogwood.	Eastern redcedar, Russian-olive, Siberian crabapple, nannyberry viburnum.	Common hackberry, eastern white pine, red pine.	---	---
Lamont-----	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
Fayette-----	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
293F*: Chelsea-----	Siberian peashrub, gray dogwood.	Eastern redcedar, Russian-olive.	---	---	---
Lamont-----	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Norway spruce, common hackberry.	---	---
Fayette-----	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, Norway spruce.	---
302B, 302C, 302C2- Coggon	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
315*. Fluvaquents					

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
350, 350B----- Waukegan	---	Siberian crabapple, lilac, American plum, Tatarian honeysuckle.	Eastern redcedar, red pine, northern white-cedar, common hackberry, white spruce.	Green ash-----	Eastern cottonwood.
352B----- Whittier	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
377B, 377C, 377C2----- Dinsdale	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
382----- Maxfield	Redosier dogwood	Tatarian honeysuckle.	Laurel willow, Amur maple, Zabel honeysuckle, northern white-cedar.	Green ash-----	Silver maple, eastern cottonwood.
391B*: Clyde-----	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
Floyd-----	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
398----- Tripoli	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
399----- Readlyn	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
407B----- Schley	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
408B, 408C----- Olin	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
412C, 412D, 412F. Sogn					
420, 420B----- Tama	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
426B, 426C----- Aredale	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
428B----- Ely	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
485----- Spillville	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
536----- Hanlon	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
727----- Udolpho	---	Northern white-cedar, tall purple willow, Tatarian honeysuckle, lilac.	Norway spruce-----	Silver maple, green ash.	Eastern cottonwood.
729B*: Nodaway----- Radford.	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
771B, 771C, 771C2- Waubeeek	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
778, 778B----- Sattre	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
782B, 782C2----- Donnan	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
1043----- Bremer	Redosier dogwood	Zabel honeysuckle, Tatarian honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
1088----- Nevin	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Red pine, common hackberry, Norway spruce.	Eastern cottonwood, silver maple.
1119----- Muscatine	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
1133----- Colo	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Laurel willow, Amur maple, northern white-cedar.	Green ash-----	Silver maple, eastern cottonwood.
1160----- Walford	Redosier dogwood	Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash-----	Eastern cottonwood, silver maple.
1291----- Atterberry	Gray dogwood-----	Autumn-olive-----	Russian-olive-----	Norway spruce-----	Silver maple.
1485----- Spillville	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
1688----- Koszta	Redosier dogwood, gray dogwood.	Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
11B*: Colo-----	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.
Ely-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
41----- Sparta	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
41B----- Sparta	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.
41C----- Sparta	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
41D----- Sparta	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.
51----- Vesser	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
54----- Zook	Severe: wetness, floods.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.
63B----- Chelsea	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.
63C----- Chelsea	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
63D----- Chelsea	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.
63F----- Chelsea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
65E2, 65F----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
65F3----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
83B----- Kenyon	Slight-----	Slight-----	Moderate: slope.	Slight.
83C, 83C2----- Kenyon	Slight-----	Slight-----	Severe: slope.	Slight.
83D, 83D2----- Kenyon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
84----- Clyde	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods, wetness.	Moderate: wetness, floods.
109C----- Backbone	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
110B----- Lamont	Slight-----	Slight-----	Moderate: slope.	Slight.
110C----- Lamont	Slight-----	Slight-----	Severe: slope.	Slight.
118----- Garwin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
119----- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
119B----- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
120----- Tama	Slight-----	Slight-----	Slight-----	Slight.
120B----- Tama	Slight-----	Slight-----	Moderate: slope.	Slight.
120C, 120C2----- Tama	Slight-----	Slight-----	Severe: slope.	Slight.
122----- Sperry	Severe: percs slowly, wetness, ponding.	Severe: wetness.	Severe: percs slowly, wetness, ponding.	Severe: wetness.
127----- Wiota	Severe: floods.	Slight-----	Moderate: slope.	Slight.
133----- Colo	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
159----- Finchford	Severe: floods.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
162B----- Downs	Slight-----	Slight-----	Moderate: slope.	Slight.
162C, 162C2----- Downs	Slight-----	Slight-----	Severe: slope.	Slight.
162D, 162D2----- Downs	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
163B----- Fayette	Slight-----	Slight-----	Moderate: slope.	Slight.
163C, 163C2----- Fayette	Slight-----	Slight-----	Severe: slope.	Slight.
163D, 163D2----- Fayette	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
163E, 163E2, 163F, 163F2----- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
163G----- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
171B----- Bassett	Slight-----	Slight-----	Moderate: slope.	Slight.
171C, 171C2----- Bassett	Slight-----	Slight-----	Severe: slope.	Slight.
171D, 171D2----- Bassett	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
175----- Dickinson	Slight-----	Slight-----	Slight-----	Slight.
175B----- Dickinson	Slight-----	Slight-----	Moderate: slope.	Slight.
175C----- Dickinson	Slight-----	Slight-----	Severe: slope.	Slight.
177----- Saude	Slight-----	Slight-----	Slight-----	Slight.
177B----- Saude	Slight-----	Slight-----	Moderate: slope.	Slight.
177C----- Saude	Slight-----	Slight-----	Severe: slope.	Slight.
178----- Waukee	Slight-----	Slight-----	Slight-----	Slight.
178B----- Waukee	Slight-----	Slight-----	Moderate: slope.	Slight.
184B----- Klinger	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
198B----- Floyd	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
207C----- Whalan	Slight-----	Slight-----	Moderate: depth to rock, slope, perms slowly.	Slight.
214C----- Rockton	Slight-----	Slight-----	Moderate: depth to rock, slope.	Slight.
220----- Nodaway	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
221B----- Palms	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.
226----- Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
284----- Flagler	Slight-----	Slight-----	Slight-----	Slight.
284B----- Flagler	Slight-----	Slight-----	Moderate: slope.	Slight.
285C----- Burkhardt	Slight-----	Slight-----	Moderate: slope.	Slight.
291----- Atterberry	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
293C*: Chelsea-----	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
Lamont-----	Slight-----	Slight-----	Severe: slope.	Slight.
Fayette-----	Slight-----	Slight-----	Severe: slope.	Slight.
293D*: Chelsea-----	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.
Lamont-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Fayette-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
293F*: Chelsea-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
Lamont-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Fayette-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
302B----- Coggon	Slight-----	Slight-----	Moderate: slope.	Slight.
302C, 302C2----- Coggon	Slight-----	Slight-----	Severe: slope.	Slight.
315*. Fluvaquents				
350----- Waukegan	Slight-----	Slight-----	Slight-----	Slight.
350B----- Waukegan	Slight-----	Slight-----	Moderate: slope.	Slight.
352B----- Whittier	Slight-----	Slight-----	Moderate: slope.	Slight.
377B----- Dinsdale	Slight-----	Slight-----	Moderate: slope.	Slight.
377C, 377C2----- Dinsdale	Slight-----	Slight-----	Severe: slope.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
382----- Maxfield	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
391B*: Clyde-----	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods, wetness.	Moderate: wetness, floods.
Floyd-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
398----- Tripoli	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
399----- Readlyn	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
407B----- Schley	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
408B----- Olin	Slight-----	Slight-----	Moderate: slope.	Slight.
408C----- Olin	Slight-----	Slight-----	Severe: slope.	Slight.
412C----- Sogn	Severe: depth to rock.	Slight-----	Severe: depth to rock, slope.	Slight.
412D----- Sogn	Severe: depth to rock.	Moderate: slope.	Severe: depth to rock, slope.	Slight.
412F----- Sogn	Severe: slope, depth to rock.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.
420----- Tama	Slight-----	Slight-----	Slight-----	Slight.
420B----- Tama	Slight-----	Slight-----	Moderate: slope.	Slight.
426B----- Aredale	Slight-----	Slight-----	Moderate: slope.	Slight.
426C----- Aredale	Slight-----	Slight-----	Severe: slope.	Slight.
428B----- Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
485----- Spillville	Severe: floods.	Slight-----	Moderate: floods.	Slight.
536----- Hanlon	Severe: floods.	Slight-----	Moderate: floods.	Slight.
727----- Udolpho	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
729B*: Nodaway-----	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Radford-----	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness, floods.
771B----- Waubeeek	Slight-----	Slight-----	Moderate: slope.	Slight.
771C, 771C2----- Waubeeek	Slight-----	Slight-----	Severe: slope.	Slight.
778----- Sattre	Slight-----	Slight-----	Slight-----	Slight.
778B----- Sattre	Slight-----	Slight-----	Moderate: slope.	Slight.
782B----- Donnan	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly.	Slight.
782C2----- Donnan	Severe: percs slowly.	Moderate: wetness.	Severe: percs slowly, slope.	Slight.
1043----- Bremer	Severe: floods, wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: wetness, too clayey.
1088----- Nevin	Severe: floods.	Moderate: wetness.	Moderate: wetness.	Slight.
1119----- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
1133----- Colo	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: floods, wetness.
1160----- Walford	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
1291----- Atterberry	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
1485----- Spillville	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
1688----- Koszta	Severe: floods.	Moderate: wetness.	Moderate: wetness.	Slight.
5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
11B*:										
Colo-----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Ely-----	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
41, 41B-----	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sparta										
41C, 41D-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sparta										
51-----	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Vesser										
54-----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Zook										
63B, 63C-----	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Chelsea										
63D, 63F-----	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Chelsea										
65E2, 65F, 65F3----	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Lindley										
83B-----	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Kenyon										
83C, 83C2, 83D, 83D2-----	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
Kenyon										
84-----	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Clyde										
109C-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Backbone										
110B-----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Lamont										
110C-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Lamont										
118-----	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Garwin										
119, 119B-----	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Muscatine										
120, 120B-----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Tama										
120C, 120C2-----	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Tama										
122-----	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Sperry										

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
127----- Wlota	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
133----- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
159----- Finchford	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
162B----- Downs	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
162C, 162C2, 162D, 162D2----- Downs	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163B----- Fayette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163C, 163C2, 163D, 163D2----- Fayette	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
163E, 163E2, 163F, 163F2----- Fayette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
163G----- Fayette	Very poor.	Very poor.	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
171B----- Bassett	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
171C, 171C2, 171D, 171D2----- Bassett	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
175, 175B----- Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
175C----- Dickinson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
177, 177B----- Saude	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
177C----- Saude	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
178, 178B----- Waukee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
184B----- Klinger	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
198B----- Floyd	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
207C----- Whalan	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
214C----- Rockton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
220----- Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
221B----- Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Poor.
226----- Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
284, 284B----- Flagler	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
285C----- Burkhardt	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
291----- Atterberry	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
293C*: Chelsea-----	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Lamont-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Fayette-----	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
293D*: Chelsea-----	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Lamont-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Fayette-----	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
293F*: Chelsea-----	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Lamont-----	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
Fayette-----	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
302B----- Coggon	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
302C, 302C2----- Coggon	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
315*. Fluvaquents										
350, 350B----- Waukegan	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
352B----- Whittier	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
377B----- Dinsdale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
377C, 377C2----- Dinsdale	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
382----- Maxfield	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
391B*: Clyde-----	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Floyd-----	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
398----- Tripoli	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
399----- Readlyn	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
407B----- Schley	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
408B----- Olin	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
408C----- Olin	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
412C, 412D, 412F--- Sogn	Very poor.	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	---	Very poor.
420, 420B----- Tama	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
426B----- Aredale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
426C----- Aredale	Fair	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Poor.
428B----- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
485----- Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
536----- Hanlon	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
727----- Udolpho	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
729B*: Nodaway-----	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
Radford-----	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
771B----- Waubeek	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
771C, 771C2----- Waubeek	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
778, 778B----- Sattre	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
782B----- Donnan	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
782C2----- Donnan	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1043----- Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
1088----- Nevin	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Fair.
1119----- Muscatine	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1133----- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
1160----- Walford	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
1291----- Atterberry	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1485----- Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1688----- Koszta	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
5030*. Pits										
5040*.. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
11B*: Colo-----	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.
Ely-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
41, 41B----- Sparta	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
41C----- Sparta	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
41D----- Sparta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
51----- Vesser	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength.
54----- Zook	Severe: wetness, floods.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength.
63B----- Chelsea	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
63C----- Chelsea	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
63D----- Chelsea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
63F----- Chelsea	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
65E2, 65F, 65F3--- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
83B----- Kenyon	Slight-----	Slight-----	Slight-----	Slight-----	Severe: low strength.
83C, 83C2----- Kenyon	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: low strength.
83D, 83D2----- Kenyon	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
84----- Clyde	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods, frost action.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
109C----- Backbone	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock.
110B----- Lamont	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.
110C----- Lamont	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.
118----- Garwin	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength.
119, 119B----- Muscatine	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
120, 120B----- Tama	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.
120C, 120C2----- Tama	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.
122----- Sperry	Severe: wetness, ponding.	Severe: wetness, shrink-swell, ponding.	Severe: shrink-swell, wetness, ponding.	Severe: shrink-swell, wetness, ponding.	Severe: ponding, wetness, low strength.
127----- Wiota	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action, low strength.
133----- Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.
159----- Finchford	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
162B----- Downs	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.
162C, 162C2----- Downs	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.
162D, 162D2----- Downs	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.
163B----- Fayette	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.
163C, 163C2----- Fayette	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.
163D, 163D2----- Fayette	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
163E, 163E2, 163F, 163F2, 163G----- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.
171B----- Bassett	Slight-----	Slight-----	Slight-----	Slight-----	Severe: low strength.
171C, 171C2----- Bassett	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: low strength.
171D, 171D2----- Bassett	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
175, 175B----- Dickinson	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.
175C----- Dickinson	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.
177, 177B----- Saude	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: low strength.
177C----- Saude	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength.
178, 178B----- Waukee	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: low strength.
184B----- Klinger	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
198B----- Floyd	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
207C----- Whalan	Moderate: depth to rock.	Slight-----	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength, frost action.
214C----- Rockton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
220----- Nodaway	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
221B----- Palms	Severe: wetness, excess humus, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
226----- Lawler	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.
284, 284B----- Flagler	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
285C----- Burkhardt	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
291----- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
293C*: Chelsea-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
Lamont-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.
Fayette-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.
293D*: Chelsea-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Lamont-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
Fayette-----	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.
293F*: Chelsea-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lamont-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Fayette-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.
302B----- Coggon	Slight-----	Slight-----	Slight-----	Slight-----	Severe: low strength.
302C, 302C2----- Coggon	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: low strength.
315*. Fluvaquents					
350, 350B----- Waukegan	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
352B----- Whittier	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
377B----- Dinsdale	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.
377C, 377C2----- Dinsdale	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.
382----- Maxfield	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, frost action, low strength.
391B*: Clyde-----	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods, frost action.
Floyd-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
398----- Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
399----- Readlyn	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.
407B----- Schley	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.
408B----- Olin	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: frost action.
408C----- Olin	Slight-----	Slight-----	Slight-----	Moderate: slope,	Moderate: frost action.
412C----- Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
412D----- Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
412F----- Sogn	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
420, 420B----- Tama	Slight-----	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
426B----- Aredale	Slight-----	Slight-----	Slight-----	Slight-----	Severe: low strength.
426C----- Aredale	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: low strength.
428B----- Ely	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: low strength, wetness, shrink-swell.	Severe: frost action, low strength.
485----- Spillville	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
536----- Hanlon	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
727----- Udolpho	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: frost action, low strength.
729B*: Nodaway-----	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
Radford-----	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, frost action, floods.
771B----- Waubeeek	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
771C, 771C2----- Waubeeek	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.
778, 778B----- Sattre	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: low strength.
782B, 782C2----- Donnan	Moderate: wetness, too clayey.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell, frost action.
1043----- Bremer	Severe: wetness, cutbanks cave.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: shrink-swell, frost action, low strength.
1088----- Nevin	Severe: wetness, cutbanks cave.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: frost action, low strength.
1119----- Muscatine	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
1133----- Colo	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.
1160----- Walford	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.
1291----- Atterberry	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
1485----- Spillville	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
1688----- Koszta	Severe: wetness, cutbanks cave.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: frost action, low strength.
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
11B*: Colo-----	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Ely-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
41, 41B----- Sparta	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
41C----- Sparta	Slight**-----	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
41D----- Sparta	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
51----- Vesser	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
54----- Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.
63B----- Chelsea	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63C----- Chelsea	Slight**-----	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63D----- Chelsea	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63F----- Chelsea	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
65E2, 65F, 65F3----- Lindley	Severe: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
83B----- Kenyon	Moderate: percs slowly.	Moderate: slope, seepage.	Slight-----	Slight-----	Good.
83C, 83C2----- Kenyon	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
83D, 83D2----- Kenyon	Moderate: percs slowly, slope.	Severe: slope.	Slight-----	Moderate: slope.	Fair: slope.

See footnotes at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
84----- Clyde	Severe: floods, wetness.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
109C----- Backbone	Severe: depth to rock.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim.
110B----- Lamont	Slight**-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
110C----- Lamont	Slight**-----	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
118----- Garwin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
119, 119B----- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
120----- Tama	Slight-----	Moderate: seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
120B----- Tama	Slight-----	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
120C, 120C2----- Tama	Slight-----	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
122----- Sperry	Severe: percs slowly, wetness, ponding.	Severe: wetness.	Severe: wetness, ponding, too clayey.	Severe: wetness, ponding.	Poor: wetness.
127----- Wiota	Slight**-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
133----- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
159----- Finchford	Moderate: floods.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
162B----- Downs	Slight-----	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
162C, 162C2----- Downs	Slight-----	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
162D, 162D2----- Downs	Moderate: slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
163B----- Fayette	Slight-----	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
163C, 163C2----- Fayette	Slight-----	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.

See footnotes at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
163D, 163D2----- Fayette	Moderate: slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
163E, 163E2, 163F, 163F2----- Fayette	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
163G----- Fayette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
171B----- Bassett	Moderate: percs slowly.	Moderate: slope, seepage.	Slight-----	Slight-----	Good.
171C, 171C2----- Bassett	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
171D, 171D2----- Bassett	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.	Fair: slope.
175, 175B----- Dickinson	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage, too sandy.	Poor: seepage, too sandy.
175C----- Dickinson	Slight**-----	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, too sandy.	Poor: seepage, too sandy.
177, 177B----- Saude	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
177C----- Saude	Slight**-----	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
178, 178B----- Waukee	Slight**-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
184B----- Klinger	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
198B----- Floyd	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
207C----- Whalan	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
214C----- Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
220----- Nodaway	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
221B----- Palms	Severe: wetness, floods, subsides.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, hard to pack.

See footnotes at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
226----- Lawler	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Good.
284, 284B----- Flagler	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
285C----- Burkhardt	Slight**-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
291----- Atterberry	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
293C*: Chelsea-----	Slight**-----	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Lamont-----	Slight**-----	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
Fayette-----	Slight-----	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
293D*: Chelsea-----	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Lamont-----	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Fayette-----	Moderate: slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
293F*: Chelsea-----	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
Lamont-----	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage, slope.	Poor: slope.
Fayette-----	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
302B----- Coggon	Moderate: percs slowly.	Moderate: slope, seepage.	Slight-----	Slight-----	Good.
302C, 302C2----- Coggon	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
315*. Fluvaquents					

See footnotes at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
350, 350B----- Waukegan	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
352B----- Whittier	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
377B----- Dinsdale	Moderate: percs slowly.	Moderate: slope.	Slight-----	Slight-----	Good.
377C, 377C2----- Dinsdale	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
382----- Maxfield	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
391B*: Clyde-----	Severe: floods, wetness.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Floyd-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
398----- Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
399----- Readlyn	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
407B----- Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
408B----- Olin	Slight-----	Moderate: slope, seepage.	Slight-----	Slight-----	Good.
408C----- Olin	Slight-----	Severe: slope.	Slight-----	Slight-----	Good.
412C, 412D----- Sogn	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
412F----- Sogn	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
420----- Tama	Slight**-----	Moderate: seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
420B----- Tama	Slight**-----	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
426B----- Aredale	Slight-----	Severe: seepage.	Slight-----	Severe: seepage.	Good.
426C----- Aredale	Slight-----	Severe: slope, seepage.	Slight-----	Severe: seepage.	Good.
428B----- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.

See footnotes at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
485----- Spillville	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Fair: wetness.
536----- Hanlon	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Fair: wetness.
727----- Udolpho	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Fair: wetness, thin layer.
729B*: Nodaway-----	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: wetness.
Radford-----	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
771B----- Waubeeek	Slight-----	Moderate: slope, seepage.	Slight-----	Slight-----	Good.
771C, 771C2----- Waubeeek	Slight-----	Severe-----	Slight-----	Slight-----	Good.
778, 778B----- Sattre	Slight**-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
782B----- Donnan	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
782C2----- Donnan	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
1043----- Bremer	Severe: percs slowly, wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness.
1088----- Nevin	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: wetness.
1119----- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1133----- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
1160----- Walford	Severe: wetness, percs slowly.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness.	Poor: wetness.
1291----- Atterberry	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

See footnotes at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1485----- Spillville	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Fair: wetness.
1688----- Koszta	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: wetness, too clayey.
5030*, Pits					
5040*, Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

**Danger of ground water contamination.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
11B*: Colo-----	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ely-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
41, 41B, 41C----- Sparta	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
41D----- Sparta	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
51----- Vesser	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
54----- Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
63B, 63C, 63D----- Chelsea	Good-----	Good-----	Unsuited: excess fines.	Poor: too sandy.
63F----- Chelsea	Fair: slope.	Good-----	Unsuited: excess fines.	Poor: too sandy, slope.
65E2, 65F, 65F3----- Lindley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
83B, 83C, 83C2----- Kenyon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
83D, 83D2----- Kenyon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
84----- Clyde	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
109C----- Backbone	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, area reclaim.
110B, 110C----- Lamont	Good-----	Fair: excess fines.	Unsuited: excess fines.	Good.
118----- Garwin	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
119, 119B----- Muscatine	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
120, 120B, 120C, 120C2----- Tama	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
122----- Sperry	Poor: low strength, shrink-swell, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
127----- Wiota	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
133----- Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
159----- Finchford	Good-----	Good-----	Unsuited: excess fines.	Fair: too sandy.
162B, 162C, 162C2----- Downs	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
162D, 162D2----- Downs	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
163B, 163C, 163C2----- Fayette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
163D, 163D2----- Fayette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
163E, 163E2, 163F, 163F2----- Fayette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
163G----- Fayette	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
171B, 171C, 171C2----- Bassett	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
171D, 171D2----- Bassett	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
175, 175B, 175C----- Dickinson	Good-----	Fair: excess fines.	Unsuited: excess fines.	Good.
177, 177B, 177C----- Saude	Good-----	Good-----	Good-----	Good.
178, 178B----- Waukee	Good-----	Good-----	Unsuited: excess fines.	Good.
184B----- Klinger	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
198B----- Floyd	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
207C----- Whalan	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
214C----- Rockton	Poor: low strength, thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, thin layer.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
220----- Nodaway	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
221B----- Palms	Poor: wetness, low strength.	Unsuited: excess humus, excess fines.	Unsuited: excess humus, excess fines.	Poor: wetness, excess humus.
226----- Lawler	Good-----	Good-----	Good-----	Good.
284, 284B----- Flagler	Good-----	Good-----	Unsuited: excess fines.	Good.
285C----- Burkhardt	Good-----	Good-----	Good-----	Good.
291----- Atterberry	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
293C*: Chelsea-----	Good-----	Good-----	Unsuited: excess fines.	Poor: too sandy.
Lamont-----	Good-----	Fair: excess fines.	Unsuited: excess fines.	Good.
Fayette-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
293D*: Chelsea-----	Good-----	Good-----	Unsuited: excess fines.	Poor: too sandy.
Lamont-----	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: slope.
Fayette-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
293F*: Chelsea-----	Fair: slope.	Good-----	Unsuited: excess fines.	Poor: too sandy, slope.
Lamont-----	Fair: slope, low strength.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope.
Fayette-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
302B, 302C, 302C2----- Coggon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
315*. Fluvaquents				
350, 350B----- Waukegan	Good-----	Good-----	Unsuited: excess fines.	Good.
352B----- Whittier	Good-----	Fair: excess fines.	Unsuited: excess fines.	Good.
377B, 377C, 377C2----- Dinsdale	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
382----- Maxfield	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
391B*: Clyde-----	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Floyd-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
398----- Tripoli	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
399----- Readlyn	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
407B----- Schley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
408B, 408C----- Olin	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
412C, 412D----- Sogn	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
412F----- Sogn	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim, slope.
420, 420B----- Tama	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
426B, 426C----- Aredale	Fair: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
428B----- Ely	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
485----- Spillville	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
536----- Hanlon	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
727----- Udolpho	Poor: low strength.	Good-----	Unsuited: excess fines.	Good.
729B*: Nodaway-----	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Radford-----	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
771B, 771C, 771C2----- Waubeek	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
778, 778B----- Sattre	Good-----	Good-----	Unsuited: excess fines.	Fair: thin layer.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
782B, 782C2----- Donnan	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
1043----- Bremer	Poor: shrink-swell, low strength, wetness.	Good-----	Unsuited: excess fines.	Fair: too clayey.
1088----- Nevin	Poor: low strength.	Fair: excess fines.	Unsuited: excess fines.	Good.
1119----- Muscatine	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1133----- Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1160----- Walford	Poor: wetness, shrink-swell, low strength.	Good-----	Unsuited: excess fines.	Good.
1291----- Atterberry	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
1485----- Spillville	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1688----- Koszta	Poor: low strength.	Fair: excess fines.	Unsuited: excess fines.	Fair: thin layer.
5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
11B*: Colo-----	Seepage-----	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Wetness-----	Wetness.
Ely-----	Seepage-----	Hard to pack, wetness.	Frost action---	Favorable-----	Erodes easily, wetness.	Erodes easily.
41----- Sparta	Seepage-----	Piping, seepage.	Not needed-----	Fast intake, droughty, soil blowing.	Not needed-----	Droughty.
41B----- Sparta	Seepage-----	Piping, seepage.	Not needed-----	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
41C----- Sparta	Slope, seepage.	Piping, seepage.	Not needed-----	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
41D----- Sparta	Slope, seepage.	Piping, seepage.	Not needed-----	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Slope, droughty.
51----- Vesser	Favorable-----	Wetness, hard to pack.	Floods, frost action.	Floods, wetness.	Wetness, erodes easily.	Erodes easily, wetness.
54----- Zook	Favorable-----	Hard to pack, wetness.	Floods, percs slowly, frost action.	Floods, wetness, percs slowly.	Not needed-----	Wetness, percs slowly.
63B----- Chelsea	Seepage-----	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
63C----- Chelsea	Slope, seepage.	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
63D, 63F----- Chelsea	Slope, seepage.	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
65E2, 65F, 65F3----- Lindley	Slope-----	Favorable-----	Not needed-----	Slope-----	Slope-----	Slope.
83B----- Kenyon	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
83C, 83C2----- Kenyon	Slope, seepage.	Favorable-----	Not needed-----	Slope-----	Favorable-----	Favorable.
83D, 83D2----- Kenyon	Slope, seepage.	Favorable-----	Not needed-----	Slope-----	Favorable-----	Slope.
84----- Clyde	Seepage-----	Wetness-----	Frost action, floods.	Wetness, floods.	Wetness-----	Wetness, erodes easily.
109C----- Backbone	Slope, depth to rock, seepage.	Thin layer-----	Not needed-----	Rooting depth, soil blowing, slope.	Depth to rock, soil blowing.	Slope, depth to rock.
110B----- Lamont	Seepage-----	Piping, seepage.	Not needed-----	Soil blowing---	Too sandy, soil blowing.	Favorable.
110C----- Lamont	Slope, seepage.	Piping, seepage.	Not needed-----	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
118----- Garwin	Seepage-----	Wetness, hard to pack.	Frost action---	Wetness-----	Not needed----	Wetness.
119, 119B----- Muscatine	Seepage-----	Wetness-----	Frost action---	Wetness-----	Wetness, erodes easily.	Erodes easily.
120, 120B----- Tama	Seepage-----	Favorable-----	Not needed----	Favorable-----	Erodes easily	Erodes easily.
120C, 120C2----- Tama	Slope, seepage.	Favorable-----	Not needed----	Slope-----	Erodes easily	Erodes easily.
122----- Sperry	Favorable-----	Wetness-----	Percs slowly, frost action, ponding.	Percs slowly, wetness, ponding.	Not needed----	Wetness, percs slowly, erodes easily.
127----- Wiota	Seepage-----	Favorable-----	Not needed----	Favorable-----	Erodes easily	Erodes easily.
133----- Colo	Seepage-----	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Wetness-----	Wetness.
159----- Finchford	Seepage-----	Seepage-----	Not needed----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
162B----- Downs	Seepage-----	Favorable-----	Not needed----	Favorable-----	Erodes easily	Erodes easily.
162C, 162C2----- Downs	Slope, seepage.	Favorable-----	Not needed----	Slope-----	Erodes easily	Erodes easily.
162D, 162D2----- Downs	Slope, seepage.	Favorable-----	Not needed----	Slope-----	Erodes easily	Slope, erodes easily.
163B----- Fayette	Seepage-----	Favorable-----	Not needed----	Erodes easily	Favorable-----	Erodes easily.
163C, 163C2----- Fayette	Slope, seepage.	Favorable-----	Not needed----	Slope, erodes easily.	Favorable-----	Erodes easily.
163D, 163D2----- Fayette	Slope, seepage.	Favorable-----	Not needed----	Slope, erodes easily.	Favorable-----	Slope, erodes easily.
163E, 163E2, 163F, 163F2, 163G----- Fayette	Slope, seepage.	Favorable-----	Not needed----	Slope, erodes easily.	Slope-----	Slope, erodes easily.
171B----- Bassett	Favorable-----	Favorable-----	Not needed----	Favorable-----	Favorable-----	Erodes easily.
171C, 171C2----- Bassett	Slope-----	Favorable-----	Not needed----	Slope-----	Favorable-----	Erodes easily.
171D, 171D2----- Bassett	Slope-----	Favorable-----	Not needed----	Slope-----	Favorable-----	Slope, erodes easily.
175, 175B----- Dickinson	Seepage-----	Seepage-----	Not needed----	Soil blowing---	Soil blowing, too sandy.	Favorable.
175C----- Dickinson	Slope, seepage.	Seepage-----	Not needed----	Soil blowing, slope.	Soil blowing, too sandy.	Favorable.
177, 177B----- Saude	Seepage-----	Seepage-----	Not needed----	Favorable-----	Too sandy-----	Favorable.
177C----- Saude	Slope, seepage.	Seepage-----	Not needed----	Slope-----	Too sandy-----	Favorable.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
178, 178B----- Waukee	Seepage-----	Seepage-----	Not needed-----	Favorable-----	Too sandy-----	Favorable.
184B----- Klinger	Seepage-----	Wetness-----	Frost action---	Wetness-----	Wetness, erodes easily.	Erodes easily.
198B----- Floyd	Seepage-----	Wetness-----	Frost action---	Wetness-----	Wetness-----	Favorable.
207C----- Whalan	Depth to rock	Thin layer----	Not needed-----	Rooting depth	Depth to rock	Depth to rock.
214C----- Rockton	Depth to rock, seepage.	Thin layer----	Not needed-----	Rooting depth	Depth to rock	Depth to rock.
220----- Nodaway	Seepage-----	Favorable-----	Not needed-----	Floods, erodes easily.	Not needed-----	Erodes easily.
221B----- Palms	Seepage-----	Excess humus, wetness.	Floods, frost action, excess humus.	Wetness, soil blowing, floods.	Not needed-----	Wetness.
226----- Lawler	Seepage-----	Seepage-----	Frost action---	Wetness-----	Wetness, too sandy.	Favorable.
284, 284B----- Flagler	Seepage-----	Seepage-----	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
285C----- Burkhardt	Seepage-----	Seepage-----	Not needed-----	Droughty, soil blowing.	Soil blowing, too sandy.	Droughty.
291----- Atterberry	Favorable-----	Hard to pack, wetness.	Frost action---	Wetness-----	Wetness, erodes easily.	Wetness, erodes easily.
293C*; Chelsea-----	Slope, seepage.	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Lamont-----	Slope, seepage.	Piping, seepage.	Not needed-----	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.
Fayette-----	Slope, seepage.	Favorable-----	Not needed-----	Slope, erodes easily.	Favorable-----	Erodes easily.
293D*, 293F*; Chelsea-----	Slope, seepage.	Piping, seepage.	Not needed-----	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Lamont-----	Slope, seepage.	Piping, seepage.	Not needed-----	Slope, soil blowing.	Too sandy, soil blowing, slope.	Slope.
Fayette-----	Slope, seepage.	Favorable-----	Not needed-----	Slope, erodes easily.	Slope-----	Slope, erodes easily.
302B----- Coggon	Favorable-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
302C, 302C2----- Coggon	Slope-----	Favorable-----	Not needed-----	Slope-----	Favorable-----	Favorable.
315*. Fluvaquents						
350, 350B----- Waukegan	Seepage-----	Seepage-----	Not needed-----	Favorable-----	Erodes easily, too sandy.	Erodes easily.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
352B----- Whittier	Seepage-----	Seepage, piping.	Not needed-----	Favorable-----	Erodes easily, too sandy.	Erodes easily.
377B----- Dinsdale	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
377C, 377C2----- Dinsdale	Slope, seepage.	Favorable-----	Not needed-----	Slope-----	Favorable-----	Erodes easily.
382----- Maxfield	Seepage-----	Wetness, hard to pack.	Frost action----	Wetness-----	Not needed-----	Wetness.
391B*: Clyde-----	Seepage-----	Wetness-----	Frost action, floods.	Wetness, floods.	Wetness-----	Wetness, erodes easily.
Floyd-----	Seepage-----	Wetness-----	Frost action----	Wetness-----	Wetness-----	Favorable.
398----- Tripoli	Favorable-----	Wetness-----	Frost action----	Wetness-----	Not needed-----	Wetness.
399----- Readlyn	Favorable-----	Wetness-----	Frost action----	Wetness-----	Wetness-----	Favorable.
407B----- Schley	Seepage-----	Wetness-----	Frost action----	Wetness-----	Wetness-----	Favorable.
408B----- Olin	Favorable-----	Favorable-----	Not needed-----	Soil blowing---	Soil blowing---	Favorable.
408C----- Olin	Slope-----	Favorable-----	Not needed-----	Soil blowing, slope.	Soil blowing---	Favorable.
412C----- Sogn	Slope, depth to rock.	Thin layer-----	Not needed-----	Droughty, rooting depth, slope.	Depth to rock	Droughty, rooting depth.
412D, 412F----- Sogn	Slope, depth to rock.	Thin layer-----	Not needed-----	Droughty, rooting depth, slope.	Depth to rock, slope.	Slope, droughty, rooting depth.
420, 420B----- Tama	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Erodes easily	Erodes easily.
426B----- Aredale	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
426C----- Aredale	Slope, seepage.	Favorable-----	Not needed-----	Slope-----	Favorable-----	Favorable.
428B----- Ely	Seepage-----	Hard to pack, wetness.	Frost action----	Favorable-----	Erodes easily, wetness.	Erodes easily.
485----- Spillville	Seepage-----	Favorable-----	Not needed-----	Floods-----	Favorable-----	Favorable.
535----- Hanlon	Seepage-----	Seepage-----	Floods-----	Floods, soil blowing.	Not needed-----	Favorable.
727----- Udolpho	Seepage-----	Seepage, wetness.	Frost action----	Wetness-----	Not needed-----	Wetness.
729B*: Nodaway-----	Seepage-----	Favorable-----	Not needed-----	Floods, erodes easily.	Not needed-----	Erodes easily.
Radford-----	Seepage-----	Wetness-----	Frost action, floods.	Wetness, floods.	Wetness-----	Wetness.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
771B----- Waubek	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Erodes easily	Erodes easily.
771C, 771C2----- Waubek	Slope, seepage.	Favorable-----	Not needed-----	Slope-----	Erodes easily	Erodes easily.
778, 778B----- Sattre	Seepage-----	Seepage-----	Not needed-----	Favorable-----	Too sandy-----	Favorable.
782B----- Donnan	Favorable-----	Hard to pack, wetness.	Percs slowly, frost action.	Percs slowly, wetness.	Wetness, percs slowly.	Percs slowly.
782C2----- Donnan	Slope-----	Hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Wetness, percs slowly.	Percs slowly.
1043----- Bremer	Seepage-----	Seepage, wetness.	Frost action---	Wetness-----	Not needed-----	Wetness.
1088----- Nevin	Seepage-----	Wetness-----	Frost action---	Wetness-----	Not needed-----	Favorable.
1119----- Muscatine	Seepage-----	Wetness-----	Frost action---	Wetness-----	Wetness, erodes easily.	Erodes easily.
1133----- Colo	Seepage-----	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Wetness-----	Wetness.
1160----- Walford	Seepage-----	Hard to pack, wetness.	Frost action, percs slowly.	Wetness, percs slowly.	Not needed-----	Wetness, erodes easily, percs slowly.
1291----- Atterberry	Favorable-----	Hard to pack, wetness.	Frost action---	Wetness-----	Wetness, erodes easily.	Wetness, erodes easily.
1485----- Spillville	Seepage-----	Favorable-----	Not needed-----	Floods-----	Favorable-----	Favorable.
1688----- Koszta	Seepage-----	Wetness, seepage.	Frost action---	Wetness-----	Not needed-----	Favorable.
5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
11B#:											
Colo-----	0-38	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	38-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
Ely-----	0-34	Silt loam, silty clay loam.	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	34-58	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	58-65	Silt loam, loam, sandy loam.	SC, CL-ML, SM-SC	A-6, A-4	0	100	100	75-100	30-95	15-40	5-20
41, 41B, 41C, 41D--	0-28	Loamy fine sand	SM, ML	A-2, A-4	0	100	100	60-95	20-55	---	NP
Sparta	28-72	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	100	100	60-95	5-50	---	NP
51-----	0-11	Silt loam-----	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
Vesser	11-19	Silt loam-----	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	19-60	Silty clay loam	CL, CH	A-7	0	100	100	98-100	95-100	40-55	20-30
54-----	0-26	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
Zook	26-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
63B, 63C, 63D, 63F--	0-4	Loamy fine sand	SM, SP-SM	A-2	0	100	100	65-80	10-35	---	NP
Chelsea	4-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2	0	100	100	65-80	3-15	---	NP
65E2, 65F-----	0-7	Loam-----	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	50-65	15-30	5-15
Lindley	7-49	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	49-60	Loam, clay loam	CL	A-6, A-7	0	95-100	90-100	85-95	50-75	30-45	15-25
65F3-----	0-7	Clay loam-----	CL	A-6	0	95-100	90-100	85-95	55-75	30-40	10-20
Lindley	7-49	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	15-25
	49-60	Loam, clay loam	CL	A-6, A-7	0	95-100	90-100	85-95	50-75	30-45	15-25
83B, 83C, 83C2, 83D, 83D2-----	0-18	Loam-----	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
Kenyon	18-54	Loam, clay loam	CL	A-6	0-5	90-95	85-95	80-90	50-65	30-40	10-20
	54-60	Loam-----	CL	A-6	0-5	90-95	85-95	80-90	50-65	25-35	10-20
84-----	0-23	Silty clay loam	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
Clyde	23-32	Clay loam, silty clay loam, loam	CL, ML	A-6, A-7	0	95-100	90-95	75-90	50-75	30-50	10-20
	32-41	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	41-65	Loam-----	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
109C-----	0-9	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	75-85	15-40	15-25	5-10
Backbone	9-32	Sandy loam, fine sandy loam.	SC, SM-SC	A-2, A-4	0-2	90-100	90-100	65-90	20-50	<30	5-10
	32-34	Clay loam, clay, silty clay.	CL, CH	A-6, A-7	2-5	90-95	90-95	70-80	50-75	35-55	20-30
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
110B, 110C-----	0-10	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	80-95	25-50	15-25	5-10
Lamont	10-25	Fine sandy loam, loam, sandy clay loam.	SM-SC, SC	A-2, A-4	0	100	100	85-95	30-50	20-30	5-10
	25-60	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	70-90	5-25	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
118----- Garwin	0-22	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	22-48	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	48-70	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	15-20
119, 119B----- Muscatine	0-20	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	20-46	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	46-60	Silt loam-----	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
120, 120B, 120C, 120C2----- Tama	0-15	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	95-100	35-50	10-20
	15-56	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	56-66	Silt loam, loam, sandy loam.	CL-ML, SM-SC	A-6, A-4	0-5	80-100	85-100	80-100	30-95	15-40	5-25
122----- Sperry	0-22	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	5-15
	22-46	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	25-35
	46-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	95-100	40-50	20-30
127----- Wiota	0-16	Silt loam, silty clay loam.	ML, CL,	A-4, A-6	0	100	100	100	90-95	30-40	5-15
	16-47	Silty clay loam	CL	A-7	0	100	100	100	80-95	40-50	15-25
	47-60	Sandy loam, loamy sand, sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	95-100	80-90	5-20	<20	NP-5
133----- Colo	0-38	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	38-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
159----- Finchford	0-19	Loamy sand-----	SP-SM, SM	A-2, A-3	0	85-95	70-80	50-60	5-15	---	NP
	19-37	Coarse sand, loamy sand, sand.	SW-SM, SP-SM	A-1	0	80-90	60-70	25-40	5-10	---	NP
	37-60	Coarse sand, loamy sand.	SW, SW-SM, SP, SP-SM	A-1	0	75-95	55-80	20-60	3-12	---	NP
162B, 162C, 162C2, 162D, 162D2----- Downs	0-10	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	10-42	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-25
	42-60	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	10-20
163B, 163C, 163C2, 163D, 163D2, 163E, 163E2, 163F, 163F2, 163G----- Fayette	0-14	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	14-46	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	46-60	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	10-20
171B, 171C, 171C2, 171D, 171D2----- Bassett	0-18	Loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	65-85	20-30	5-15
	18-48	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	10-20
	48-60	Loam-----	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	10-20
175, 175B, 175C---- Dickinson	0-16	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	16-26	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	26-31	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	31-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
177, 177B, 177C--- Saude	0-13	Loam-----	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
	13-27	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	36-60	20-30	5-15
	27-60	Loamy sand, gravelly sand, sand.	SW, SM, GP, GM	A-1	2-10	50-90	50-85	20-40	3-25	---	NP
178, 178B----- Waukee	0-23	Loam-----	CL	A-6	0	100	90-100	70-90	50-75	30-40	10-20
	23-37	Loam, sandy clay loam.	CL, SM-SC, SC, CL-ML	A-6, A-4	0-5	85-95	80-95	65-85	40-60	20-35	5-15
	37-60	Gravelly sand, loamy coarse sand.	SW, SM, SP-SM, SP	A-1	2-10	60-90	60-85	20-40	3-25	---	NP
184B----- Klinger	0-17	Silty clay loam	CL, ML	A-7	0	100	100	100	95-100	40-50	15-25
	17-39	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	39-60	Loam, clay loam	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
198B----- Floyd	0-23	Loam-----	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	23-34	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	34-43	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	43-76	Loam-----	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
207C----- Whalan	0-5	Loam-----	ML	A-4	0	100	95-100	85-95	60-90	30-40	5-10
	5-26	Clay loam, loam	CL	A-6	0	95-100	95-100	80-95	70-90	30-40	10-15
	26-28	Clay loam, clay, silty clay.	CL, CH	A-7	0-5	80-100	70-95	65-90	50-85	40-60	20-35
	28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
214C----- Rockton	0-17	Loam-----	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	17-24	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	24-26	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	90-100	90-100	90-95	70-90	40-60	20-35
	26	Weathered bedrock.	---	---	---	---	---	---	---	---	---
220----- Nodaway	0-60	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
221B----- Palms	0-26	Sapric material	Pt	---	---	---	---	---	---	---	---
	26-60	Silty clay loam, fine sandy loam, silt loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-95	25-40	5-20
226----- Lawler	0-21	Loam-----	OL, CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	21-34	Loam, sandy clay loam, sandy loam.	CL, SC	A-6, A-2	0-5	85-95	80-95	50-85	25-65	15-40	5-20
	34-65	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
284, 284B----- Flagler	0-23	Sandy loam-----	SC, SM-SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	23-29	Sandy loam-----	SC, SM-SC	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	29-65	Loamy sand, gravelly sand, sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
285C----- Burkhardt	0-11	Sandy loam-----	SM, SM-SC	A-2, A-4	0	95-100	95-100	60-70	25-40	<20	2-7
	11-15	Sandy loam, loam	SM, ML, SC, CL	A-2, A-4	0	95-100	85-100	60-95	25-60	15-30	2-10
	15-60	Sand and gravel	SP, GP	A-1	0	50-75	45-75	20-35	1-5	---	NP
291----- Atterberry	0-14	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	14-48	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	40-55	20-30
	48-60	Silt loam-----	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
293C*, 293D*, 293F*: Chelsea-----	0-4	Loamy fine sand	SM, SP-SM	A-2	0	100	100	65-80	10-35	---	NP
	4-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2	0	100	100	65-80	3-15	---	NP
Lamont-----	0-10	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	80-95	25-50	15-25	5-10
	10-25	Fine sandy loam, loam, sandy clay loam, sandy loam.	SM-SC, SC	A-2, A-4	0	100	100	85-95	30-50	20-30	5-10
	25-60	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	70-90	5-25	---	NP
Fayette-----	0-14	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	14-46	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	46-60	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	10-20
302B, 302C, 302C2-- Coggon	0-15	Loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	90-95	65-85	20-30	5-15
	15-56	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	10-20
	56-60	Loam-----	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	10-20
315*. Fluvaquents											
350, 350B----- Waukegan	0-13	Silt loam-----	ML	A-4	0	95-100	95-100	95-100	85-95	25-40	3-10
	13-36	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	95-100	95-100	95-100	85-95	25-40	5-15
	36-60	Gravelly coarse sand, loamy sand, sand.	SP, SW, SP-SM, SM	A-1, A-2	0-2	80-95	65-85	30-50	3-20	---	NP
352B----- Whittier	0-7	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-95	25-35	5-15
	7-27	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-95	35-45	15-25
	27-31	Loam, sandy loam	CL, SC	A-6, A-4	0	100	95-100	80-90	45-75	25-40	8-20
	31-60	Loamy fine sand, fine sand, loamy sand.	SM, SM-SC, SP-SM	A-2, A-3	0	100	95-100	80-90	5-20	<20	NP-5
377B, 377C, 377C2-- Dinsdale	0-14	Silty clay loam	ML, CL,	A-6, A-7	0	100	100	100	95-100	30-50	10-20
	14-38	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	38-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
382----- Maxfield	0-21	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	21-37	Silty clay loam, silt loam.	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	37-60	Loam-----	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
391B*: Clyde-----	0-23	Silty clay loam	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	23-32	Clay loam, silty clay loam, loam.	CL, ML	A-6, A-7	0	95-100	90-95	75-90	50-75	30-50	10-20
	32-41	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	41-65	Loam-----	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
Floyd-----	0-23	Loam-----	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	23-34	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	34-43	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	43-76	Loam-----	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
398----- Tripoli	0-17	Clay loam-----	CL	A-6, A-7	0	100	100	85-95	55-75	35-45	15-25
	17-39	Clay loam, loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	11-20
	39-60	Loam, sandy clay loam, clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	11-20
399----- Readlyn	0-19	Loam-----	CL	A-6	0	100	100	85-95	55-75	30-40	15-25
	19-46	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	10-20
	46-65	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	25-35	10-20
407B----- Schley	0-18	Loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	80-90	55-75	25-40	5-15
	18-45	Loam, sandy loam, silty clay loam.	CL, SC, SM-SC, CL-ML	A-2, A-4	2-8	90-95	70-80	50-70	20-60	20-30	5-10
	45-60	Loam, sandy clay loam, clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-40	10-20
408B, 408C----- Olin	0-28	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	95-100	85-95	30-50	20-30	5-10
	28-53	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-95	80-90	45-65	25-35	10-20
	53-62	Loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	25-35	10-20
412C, 412D, 412F--- Sogn	0-12	Loam-----	CL	A-6, A-7	0-10	85-100	85-100	85-100	80-95	25-45	11-23
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
420, 420B----- Tama	0-15	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	95-100	35-50	10-20
	15-56	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	56-66	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
426B, 426C----- Aredale	0-19	Loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	55-75	25-35	5-15
	19-27	Loam, clay loam	CL, SC	A-6	2-5	90-95	85-95	80-90	40-60	30-40	10-20
	27-42	Sandy loam, loam, loamy sand.	SC, SM, SM-SC	A-2, A-4 A-6	2-5	90-95	85-95	70-90	20-50	15-35	NP-20
	42-65	Loam-----	CL	A-6	2-5	90-95	85-95	80-90	50-65	25-35	11-20
428B----- Ely	0-34	Silt loam, silty clay loam.	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	34-58	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	58-65	Silt loam, loam, sandy loam.	CL, CL-ML	A-6, A-4	0	100	100	75-100	70-100	15-40	5-20

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
485----- Spillville	0-52	Loam-----	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	52-60	Sandy clay loam, loam, sandy loam, fine sand.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	<40	NP-15
536----- Hanlon	0-48	Fine sandy loam, sandy loam.	SM-SC, SC, SM	A-4	0	100	100	75-80	35-50	25-35	5-10
	48-60	Sandy loam, fine sandy loam, loamy fine sand.	SM-SC, SC	A-4, A-2	0	100	100	75-80	25-40	15-25	5-10
727----- Udolpho	0-16	Loam-----	CL, ML, CL-ML	A-4,	0	100	90-100	70-90	50-75	25-35	5-10
	16-36	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0-2	95-100	85-100	80-95	60-85	30-50	10-20
	36-60	Coarse sand, sand, gravelly sand, loamy sand.	SP, SM, SP-SM, SW	A-1	10-25	75-90	60-80	20-45	0-15	---	NP
729B*: Nodaway-----	0-60	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
Radford-----	0-27	Silt loam-----	ML, CL	A-4, A-6	0	100	100	95-100	80-100	30-40	5-15
	27-60	Silty clay loam, clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	80-95	35-50	15-25
771B, 771C, 771C2-- Waubeek	0-7	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	100	100	25-35	5-15
	7-33	Silty clay loam	CL	A-7	0	100	100	100	100	40-50	15-25
	33-63	Loam, sandy clay loam, clay loam.	CL	A-6	0-5	90-95	85-95	75-85	50-65	25-35	10-20
778, 778B----- Sattre	0-13	Loam-----	CL, CL-ML, ML	A-4	0	100	90-100	70-90	50-75	25-35	5-10
	13-35	Loam, sandy clay loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	40-60	20-35	5-15
	35-60	Gravelly coarse sand, sand, gravelly sand.	SW, SM, SP, SP-SM	A-1	2-10	60-85	50-70	20-40	3-25	---	NP
782B, 782C2----- Donnan	0-8	Loam, silt loam	CL, ML, CL-ML	A-4, A-6	0	100	100	70-95	50-80	25-40	5-20
	8-25	Clay loam, silty clay loam, loam, sandy loam.	CL, SC, CL-ML, SM-SC	A-6, A-7 A-4	0-5	95-100	85-95	60-90	50-75	15-50	5-30
	25-60	Clay, silty clay	CH	A-7	0-5	95-100	90-95	80-90	60-75	55-70	30-40
1043----- Bremer	0-20	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-60	25-40
	20-47	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	47-60	Loamy coarse sand, loamy sand, sand.	SP, SP-SM SM-SC	A-1, A-2, A-3	0	85-95	50-60	40-60	3-12	<20	NP-5
1088----- Nevin	0-17	Silty clay loam	ML, CL	A-6, A-7	0	100	100	100	90-95	35-45	11-20
	17-44	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	44-55	Loam, sandy loam	CL, SC, SM-SC	A-4, A-6	0	100	95-100	80-90	35-70	20-30	5-15
	55-60	Loamy sand, sandy loam, sand.	SM, SP-SM, SM-SC	A-2, A-3, A-1	0	100	95-100	80-90	5-20	<20	NP-5

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1119----- Muscatine	0-20	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	20-46	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	46-60	Silt loam-----	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
1133----- Colo	0-38	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	38-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
1160----- Walford	0-16	Silt loam-----	CL	A-6	0	100	100	100	95-100	25-35	10-20
	16-47	Silty clay loam	CL, CH	A-7	0	100	100	100	90-100	45-55	20-30
	47-60	Gravelly loamy sand, loamy sand, sand.	SW, SW-SM	A-1, A-3	0-5	90-95	85-95	40-60	3-10	---	NP
1291----- Atterberry	0-14	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	14-48	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	40-55	20-30
	48-60	Silt loam-----	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
1485----- Spillville	0-52	Loam-----	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	52-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
1688----- Koszta	0-13	Silt loam-----	CL	A-6	0	100	100	100	90-95	30-40	11-20
	13-51	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	51-60	Sandy loam, loamy sand, sand.	SM, SP-SM, SM-SC	A-2, A-3 A-1	0	100	95-100	80-90	5-20	<20	NP-5
5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated.]

Soil name and map symbol	Depth	Permeability		Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
		In	In/hr				K	T		
11B*:										
Colo-----	0-38	0.6-2.0		0.21-0.23	5.6-7.3	High-----	0.28	5	7	5-7
	38-60	0.6-2.0		0.18-0.20	6.1-7.3	High-----	0.28			
Ely-----	0-34	0.6-2.0		0.21-0.23	5.6-7.3	Moderate	0.32	5	7	5-6
	34-58	0.6-2.0		0.18-0.20	6.1-7.3	Moderate	0.43			
	58-65	0.6-2.0		0.18-0.20	6.6-8.4	Moderate	0.43			
41, 41B, 41C, 41D-----	0-28	2.0-6.0		0.10-0.12	5.1-7.3	Low-----	0.17	5	2	<0.5-1.5
Sparta	28-72	6.0-20		0.06-0.11	5.1-6.0	Low-----	0.17			
51-----	0-11	0.6-2.0		0.20-0.24	5.6-7.3	Moderate	0.32	5	7	2.5-3.5
Vesser	11-19	0.6-2.0		0.18-0.22	5.1-6.0	Moderate	0.43			
	19-60	0.6-2.0		0.17-0.21	5.6-6.5	Moderate	0.43			
54-----	0-26	0.2-0.6		0.21-0.23	5.6-7.8	High-----	0.28	5	7	5.0-6.0
Zook	26-60	0.06-0.2		0.11-0.13	5.6-7.8	High-----	0.28			
63B, 63C, 63D, 63F-----	0-4	6.0-20		0.10-0.15	5.6-7.3	Low-----	0.17	5	2	<0.5-1.0
Chelsea	4-60	6.0-20		0.06-0.08	5.1-6.5	Low-----	0.17			
65E2, 65F-----	0-7	0.6-2.0		0.16-0.18	4.5-6.0	Low-----	0.32	5	6	<0.5
Lindley	7-49	0.2-0.6		0.14-0.18	4.5-6.5	Moderate	0.32			
	49-60	0.2-0.6		0.12-0.16	6.1-7.8	Moderate	0.32			
65F3-----	0-7	0.2-0.6		0.14-0.18	4.5-6.0	Moderate	0.32	4	6	<0.5
Lindley	7-49	0.2-0.6		0.14-0.18	4.5-6.5	Moderate	0.32			
	49-60	0.2-0.6		0.12-0.16	6.1-7.8	Moderate	0.32			
83B, 83C, 83C2, 83D, 83D2-----	0-18	0.6-2.0		0.20-0.22	5.6-7.3	Low-----	0.28	5	6	1.0-4.0
Kenyon	18-54	0.6-2.0		0.17-0.19	5.1-7.3	Low-----	0.28			
	54-60	0.6-2.0		0.17-0.19	6.6-7.8	Low-----	0.37			
84-----	0-23	0.6-2.0		0.21-0.23	6.6-7.3	Moderate	0.28	5	7	9-11
Clyde	23-32	0.6-2.0		0.18-0.20	6.6-7.3	Moderate	0.37			
	32-41	2.0-6.0		0.11-0.13	6.6-7.3	Low-----	0.37			
	41-65	0.6-2.0		0.17-0.19	6.6-8.4	Moderate	0.37			
109C-----	0-9	2.0-6.0		0.12-0.14	6.6-7.3	Low-----	0.24	4	3	0.5-1.0
Backbone	9-32	2.0-6.0		0.11-0.13	5.1-7.3	Low-----	0.24			
	32-34	0.2-0.6		0.14-0.16	5.6-7.3	High-----	0.24			
	34	---		---	---	---	---			
110B, 110C-----	0-10	2.0-6.0		0.16-0.18	5.1-7.3	Low-----	0.24	5	3	<0.5-1.0
Lamont	10-25	2.0-6.0		0.14-0.16	5.1-6.0	Low-----	0.24			
	25-60	>20		0.09-0.11	5.1-6.5	Low-----	0.17			
118-----	0-22	0.6-2.0		0.21-0.23	5.6-7.3	High-----	0.28	5	7	5.5-6.5
Garwin	22-48	0.6-2.0		0.18-0.20	6.1-7.3	High-----	0.28			
	48-70	0.6-2.0		0.20-0.22	6.6-7.8	Moderate	0.28			
119, 119B-----	0-20	0.6-2.0		0.22-0.24	5.1-7.3	Moderate	0.28	5	6	4.5-6.0
Muscataine	20-46	0.6-2.0		0.18-0.20	5.1-7.3	Moderate	0.43			
	46-60	0.6-2.0		0.18-0.20	6.6-7.8	Moderate	0.43			
120, 120B, 120C, 120C2-----	0-15	0.6-2.0		0.22-0.24	5.1-7.3	Moderate	0.32	5	7	2.0-4.5
Tama	15-56	0.6-2.0		0.18-0.20	5.1-6.0	Moderate	0.43			
	56-66	0.6-2.0		0.18-0.20	5.6-7.3	Moderate	0.43			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink- swell potential	Erosion factors		Wind erodibility group	Organic matter
						K	T		
	In	In/hr	In/in	pH					Pct
122----- Sperry	0-22 22-46 46-60	0.6-2.0 <0.2 0.2-0.6	0.22-0.24 0.14-0.16 0.19-0.21	5.6-7.3 5.1-6.5 5.6-6.5	Moderate High----- High-----	0.28 0.43 0.43	5	6	3-4
127----- Wiota	0-16 16-47 47-60	0.6-2.0 0.6-2.0 >6.0	0.21-0.23 0.18-0.20 0.05-0.13	5.6-7.3 5.6-6.5 6.1-7.3	Moderate Moderate Low-----	0.32 0.43 0.15	5	7	3-4
133----- Colo	0-38 38-60	0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20	5.6-7.3 6.1-7.3	High----- High-----	0.28 0.28	5	7	5-7
159----- Finchford	0-19 19-37 37-60	>6.0 >20 >20	0.10-0.12 0.04-0.06 0.02-0.04	6.1-7.3 5.1-6.0 5.6-6.5	Low----- Low----- Low-----	0.17 0.17 0.17	5	2	1.0-1.5
162B, 162C, 162C2, 162D, 162D2----- Downs	0-10 10-42 42-60	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.18-0.20	5.1-7.3 4.5-6.0 5.6-7.3	Low----- Moderate Moderate	0.32 0.43 0.43	5-4	6	1.0-3.0
163B, 163C, 163C2, 163D, 163D2, 163E, 163E2, 163F, 163F2, 163G----- Fayette	0-14 14-46 46-60	0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.22 0.18-0.20 0.18-0.20	5.1-7.3 4.5-6.0 5.1-7.8	Low----- Moderate Moderate	0.37 0.37 0.37	5	6	<0.5-2.5
171B, 171C, 171C2, 171D, 171D2----- Bassett	0-18 18-48 48-60	0.6-2.0 0.6-2.0 0.6-2.0	0.19-0.21 0.17-0.19 0.17-0.19	5.1-6.5 4.5-5.5 5.1-7.8	Low----- Low----- Low-----	0.28 0.28 0.37	5-4	6	1.0-2.5
175, 175B, 175C-- Dickinson	0-16 16-26 26-31 31-60	2.0-6.0 2.0-6.0 6.0-20 6.0-20	0.12-0.15 0.12-0.15 0.08-0.10 0.02-0.04	5.6-7.3 5.6-6.5 5.6-6.5 5.6-6.5	Low----- Low----- Low----- Low-----	0.20 0.20 0.20 0.15	4	3	0.5-2.5
177, 177B, 177C-- Saude	0-13 13-27 27-60	0.6-2.0 0.6-6.0 >20	0.20-0.22 0.15-0.19 0.02-0.06	5.6-7.3 5.1-6.0 5.1-6.5	Low----- Low----- Very low	0.28 0.28 0.10	4	5	2.0-3.5
178, 178B----- Waukee	0-23 23-37 37-60	0.6-2.0 0.6-2.0 >20	0.20-0.22 0.15-0.19 0.02-0.06	5.6-7.3 5.6-6.0 5.6-6.0	Low----- Low----- Low-----	0.24 0.32 0.10	4	6	2.5-4.0
184B----- Klinger	0-17 17-39 39-60	0.6-2.0 0.6-2.0 0.6-2.0	0.22-0.24 0.18-0.20 0.17-0.19	5.1-7.3 5.1-6.5 5.6-7.8	Moderate Moderate Low-----	0.32 0.43 0.43	5	6	5-6
198B----- Floyd	0-23 23-34 34-43 43-76	0.6-2.0 0.6-2.0 2.0-6.0 0.6-2.0	0.20-0.22 0.16-0.18 0.11-0.13 0.16-0.18	6.6-7.3 6.6-7.3 6.6-7.3 6.6-7.8	Moderate Low----- Low----- Low-----	0.24 0.32 0.32 0.32	5	6	5.0-6.0
207C----- Whalan	0-5 5-26 26-28 28	0.6-2.0 0.6-2.0 0.06-0.6 ---	0.22-0.24 0.17-0.19 0.15-0.19 ---	5.6-7.3 5.1-6.5 5.6-7.8 ---	Low----- Low----- High----- -----	0.32 0.32 0.32 ---	4	6	0.5-1.0
214C----- Rockton	0-17 17-24 24-26 26	0.6-2.0 0.6-2.0 0.6-2.0 ---	0.20-0.22 0.17-0.19 0.10-0.14 ---	5.1-6.5 5.1-6.5 5.6-7.3 ---	Low----- Moderate High----- -----	0.28 0.28 0.28 ---	4	6	2.5-3.5
220----- Nodaway	0-60	0.6-2.0	0.20-0.23	6.1-7.3	Moderate	0.37	5	7	2-3

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink- swell potential	Erosion factors		Wind erodibility group	Organic matter
						K	T		
	In	In/hr	In/in	pH					Pct
221B----- Palms	0-26 26-60	0.2-6.0 0.2-2.0	0.35-0.45 0.14-0.22	5.1-8.4 6.1-8.4	----- Low-----	--- ---	---	3	>20
226----- Lawler	0-21 21-34 34-65	0.6-2.0 0.6-2.0 6.0-20	0.20-0.22 0.16-0.18 0.02-0.04	5.6-7.3 5.6-6.5 6.1-6.5	Low----- Low----- Low-----	0.28 0.28 0.10	4	6	4-5
284, 284B----- Flagler	0-23 23-29 29-65	2.0-6.0 2.0-6.0 >20	0.12-0.14 0.11-0.13 0.02-0.04	6.1-7.3 5.1-6.5 5.1-7.3	Low----- Low----- Low-----	0.20 0.20 0.20	4	3	1.0-2.5
285C----- Burkhardt	0-11 11-15 15-60	2.0-6.0 2.0-6.0 6.0-20	0.13-0.15 0.12-0.19 0.02-0.04	5.1-6.5 5.1-6.5 5.6-6.5	Low----- Low----- Low-----	0.20 0.20 0.10	3	3	0.5-1.5
291----- Atterberry	0-14 14-48 48-60	0.6-2.0 0.2-2.0 0.6-2.0	0.22-0.24 0.18-0.20 0.20-0.22	5.6-6.5 5.1-6.0 6.1-7.8	Low----- Moderate Low-----	0.32 0.43 0.43	5	6	2.5-3.5
293C*, 293D*, 293F*: Chelsea-----	0-4 4-60	6.0-20 6.0-20	0.10-0.15 0.06-0.08	5.6-7.3 5.1-6.5	Low----- Low-----	0.17 0.17	5	2	<0.5
Lamont-----	0-10 10-25 25-60	2.0-6.0 2.0-6.0 >20	0.16-0.18 0.14-0.16 0.09-0.11	5.1-7.3 5.1-6.0 5.1-6.5	Low----- Low----- Low-----	0.24 0.24 0.17	5	3	<0.5
Fayette-----	0-14 14-46 46-60	0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.22 0.18-0.20 0.18-0.20	5.1-7.3 4.5-6.0 5.1-7.8	Low----- Moderate Moderate	0.37 0.37 0.37	5	6	<0.5-2.0
302B, 302C, 302C2----- Coggon	0-15 15-56 56-60	0.6-2.0 0.6-2.0 0.6-2.0	0.18-0.20 0.17-0.19 0.17-0.19	5.1-7.3 4.5-6.0 5.1-7.8	Low----- Low----- Low-----	0.32 0.32 0.32	5-4	6	0.5-2.5
315*. Fluvaquents									
350, 350B----- Waukegan	0-13 13-36 36-60	0.6-2.0 0.6-2.0 6.0-20	0.22-0.24 0.20-0.22 0.02-0.04	5.6-7.3 5.1-7.3 5.6-7.8	Low----- Low----- Low-----	0.32 0.43 0.10	4	6	3.0-4.5
352B----- Whittier	0-7 7-27 27-31 31-60	0.6-2.0 0.6-2.0 0.6-2.0 6.0-20	0.20-0.22 0.17-0.19 0.16-0.18 0.04-0.07	5.6-7.3 5.1-6.5 5.1-6.0 5.1-6.5	Low----- Moderate Low----- Low-----	0.32 0.43 0.43 0.17	4	6	2.5-3.5
377B, 377C, 377C2----- Dinsdale	0-14 14-38 38-60	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.17-0.19	5.1-7.3 5.1-6.5 5.6-8.4	Moderate Moderate Low-----	0.32 0.43 0.43	5	7	2.0-4.0
382----- Maxfield	0-21 21-37 37-60	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.17-0.19	6.6-7.3 6.1-7.3 6.1-7.8	High----- High----- Low-----	0.24 0.32 0.32	5	6	6-7
391B*: Clyde-----	0-23 23-32 32-41 41-65	0.6-2.0 0.6-2.0 2.0-6.0 0.6-2.0	0.21-0.23 0.18-0.20 0.11-0.13 0.17-0.19	6.6-7.3 6.6-7.3 6.6-7.3 6.6-8.4	Moderate Moderate Low----- Moderate	0.28 0.37 0.37 0.37	5	7	9-11
Floyd-----	0-23 23-34 34-43 43-76	0.6-2.0 0.6-2.0 2.0-6.0 0.6-2.0	0.20-0.22 0.16-0.18 0.11-0.13 0.16-0.18	6.6-7.3 6.6-7.3 6.6-7.3 6.6-7.8	Moderate Low----- Low----- Low-----	0.24 0.32 0.32 0.32	5	6	5.0-6-0
398----- Tripoli	0-17 17-39 39-60	0.6-2.0 0.6-2.0 0.6-2.0	0.19-0.21 0.17-0.19 0.17-0.19	6.1-7.3 6.6-7.8 7.4-8.4	Moderate Low----- Low-----	0.24 0.32 0.32	5	6	6-7

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink- swell potential	Erosion factors		Wind erodibility group	Organic matter
						K	T		
	In	In/hr	In/in	pH					Pct
399----- Readlyn	0-19 19-46 46-65	0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.22 0.17-0.19 0.17-0.19	5.1-7.3 5.1-6.5 6.6-7.8	Low----- Low----- Low-----	0.24 0.32 0.32	5	6	4.5-5.5
407B----- Schley	0-18 18-45 45-60	0.6-2.0 0.6-2.0 0.6-2.0	0.19-0.21 0.12-0.16 0.16-0.18	4.5-6.5 4.5-6.0 5.1-7.8	Moderate Low----- Low-----	0.32 0.32 0.32	5	6	2.5-3.5
408B, 408C----- Olin	0-28 28-53 53-62	2.0-6.0 0.6-2.0 0.6-2.0	0.13-0.15 0.17-0.19 0.17-0.19	5.6-7.3 5.6-6.0 7.4-8.4	Low----- Low----- Low-----	0.20 0.32 0.32	5	3	0.5-1.5
412C, 412D, 412F- Sogn	0-12 12	0.6-2.0 ---	0.17-0.22 ---	6.1-8.4 ---	Moderate -----	0.28 ---	1	4L	0.5-3.5
420, 420B----- Tama	0-15 15-56 56-66	0.6-2.0 0.6-2.0 0.6-2.0	0.22-0.24 0.18-0.20 0.18-0.20	5.1-7.3 5.1-6.0 5.6-7.3	Moderate Moderate Moderate	0.32 0.43 0.43	5	7	3.0-4.5
426B, 426C----- Aredale	0-19 19-27 27-42 42-65	0.6-2.0 0.6-2.0 2.0-6.0 0.6-2.0	0.20-0.22 0.17-0.19 0.11-0.13 0.17-0.19	5.6-7.3 5.1-6.0 5.1-6.0 5.6-7.3	Low----- Low----- Low----- Low-----	0.28 0.28 0.28 0.37	5	6	2.5-4.0
428B----- Ely	0-34 34-58 58-65	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.18-0.20	5.6-7.3 6.1-7.3 6.6-8.4	Moderate Moderate Moderate	0.32 0.43 0.43	5	7	5-6
485----- Spillville	0-52 52-60	0.6-2.0 0.6-6.0	0.19-0.21 0.15-0.18	5.6-7.3 5.6-7.3	Moderate Low-----	0.28 0.28	5	6	4.5-5.5
536----- Hanlon	0-48 48-60	2.0-6.0 2.0-6.0	0.16-0.18 0.11-0.13	6.6-7.3 5.6-7.3	Low----- Low-----	0.20 0.20	5	3	2-3
727----- Udolpho	0-16 16-36 36-60	0.6-2.0 0.6-2.0 6.0-20	0.24-0.28 0.16-0.22 0.02-0.08	5.6-6.5 5.1-6.0 5.6-7.8	Moderate Moderate Low-----	0.37 0.37 0.15	5	6	2-3
729B*: Nodaway-----	0-60	0.6-2.0	0.20-0.23	6.1-7.3	Moderate	0.37	5	7	2-3
Radford-----	0-27 27-60	0.6-2.0 0.6-2.0	0.22-0.24 0.18-0.20	6.1-7.8 6.6-7.8	Low----- Moderate	0.28 0.28	5	6	2-3
771B, 771C, 771C2----- Waubeek	0-7 7-33 33-63	2.0-6.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.17-0.19	5.6-7.3 5.1-6.0 5.1-7.3	Moderate Moderate Low-----	0.32 0.43 0.43	5-4	6	1.0-3.0
778, 778B----- Sattre	0-13 13-35 35-60	0.6-2.0 0.6-6.0 >20	0.18-0.20 0.15-0.17 0.02-0.06	6.1-6.5 5.1-6.0 5.1-5.5	Low----- Low----- Low-----	0.28 0.28 0.15	4	6	1.5-2.5
782B, 782C2----- Donnan	0-8 8-25 25-60	0.6-2.0 0.6-2.0 <0.06	0.20-0.22 0.17-0.19 0.11-0.14	5.1-7.3 5.1-5.5 5.6-6.5	Low----- Moderate High-----	0.28 0.28 0.28	4	6	1.5-3.0
1043----- Bremer	0-20 20-47 47-60	0.2-0.6 0.2-0.6 >6.0	0.21-0.23 0.18-0.20 0.04-0.08	6.6-7.3 6.6-7.3 6.6-7.3	High----- High----- Low-----	0.28 0.28 0.15	5	7	5.0-7.0
1088----- Nevin	0-17 17-44 44-55 55-60	0.6-2.0 0.6-2.0 2.0-6.0 >6.0	0.21-0.23 0.18-0.20 0.11-0.17 0.05-0.10	5.6-7.3 5.6-6.0 5.6-6.0 5.6-6.0	Moderate Moderate Low----- Low-----	0.32 0.32 0.32 0.15	5	7	5-6
1119----- Muscatine	0-20 20-46 46-60	0.6-2.0 0.6-2.0 0.6-2.0	0.22-0.24 0.18-0.20 0.18-0.20	5.1-7.3 5.1-7.3 6.6-7.8	Moderate Moderate Moderate	0.28 0.43 0.43	5	6	5-6
1133----- Colo	0-38 38-60	0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20	5.6-7.3 6.1-7.3	High----- High-----	0.28 0.28	5	7	5-7

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink- swell potential	Erosion factors		Wind erodibility group	Organic matter
						K	T		
	In	In/hr	In/in	pH					Pct
1160----- Walford	0-16	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7	2.5-3.5
	16-47	0.06-0.2	0.18-0.20	5.0-6.0	High-----	0.43			
	47-60	6.0-20	0.03-0.08	5.0-6.5	Very low	0.10			
1291----- Atterberry	0-14	0.6-2.0	0.22-0.24	5.6-6.5	Low-----	0.32	5	6	2.5-3.5
	14-48	0.2-2.0	0.18-0.20	5.1-6.0	Moderate	0.43			
	48-60	0.6-2.0	0.20-0.22	6.1-7.8	Low-----	0.43			
1485----- Spillville	0-52	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.28	5	6	4.5-5.5
	52-60	0.6-6.0	0.15-0.18	5.6-7.3	Low-----	0.28			
1688----- Koszta	0-13	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7	2.5-3.0
	13-51	0.6-2.0	0.18-0.20	5.1-6.0	Moderate	0.32			
	51-60	>6.0	0.05-0.10	5.1-6.5	Low-----	0.15			
5030*, Pits									
5040*, Orthents									

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>				
11B*: Colo-----	B/D	Frequent----	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
Ely-----	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
41, 41B, 41C, 41D-Sparta	A	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Moderate.
51----- Vesser	C	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
54----- Zook	C/D	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
63B, 63C, 63D, 63F----- Chelsea	A	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Low.
65E2, 65F, 65F3--- Lindley	C	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
83B, 83C, 83C2, 83D, 83D2----- Kenyon	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
84----- Clyde	B/D	Frequent----	Very brief	Feb-Nov	1.0-2.5	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
109C----- Backbone	B	None-----	---	---	>6.0	---	---	20-40	Hard	Moderate	Low-----	Low.
110B, 110C----- Lamont	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Moderate.
118----- Garwin	B/D	None-----	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
119, 119B----- Muscatine	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
120, 120B, 120C, 120C2----- Tama	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
122----- Sperry	C/D	None-----	---	---	0-1.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
127----- Wiota	B	Rare-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES---Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth Ft	Kind	Months	Depth In	Hardness		Uncoated steel	Concrete
133----- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
159----- Finchford	A	Rare-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Low.
162B, 162C, 162C2, 162D, 162D2----- Downs	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
163B, 163C, 163C2, 163D, 163D2, 163E, 163E2, 163F, 163F2, 163G----- Fayette	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
171B, 171C, 171C2, 171D, 171D2----- Bassett	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
175, 175B, 175C--- Dickinson	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Moderate.
177, 177B, 177C--- Saude	B	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Moderate.
178, 178B----- Waukee	B	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Moderate.
184B----- Klinger	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
198B----- Floyd	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
207C----- Whalan	B	None-----	---	---	>6.0	---	---	20-40	Rippable	Moderate	Moderate	Low.
214C----- Rockton	B	None-----	---	---	>6.0	---	---	20-40	Rippable	Moderate	Low-----	Low.
220----- Nodaway	B	Frequent----	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>60	---	High-----	Moderate	Low.
221B----- Palms	A/D	Frequent----	Long-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
226----- Lawler	B	None-----	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
284, 284B----- Flagler	B	None to rare	---	---	>6.0	---	---	>60	---	Low-----	Moderate	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>				
285C----- Burkhardt	B	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	High.
291----- Atterberry	B	None-----	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
293C*, 293D*, 293F*: Chelsea-----	A	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Low.
Lamont-----	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Moderate.
Fayette-----	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
302B, 302C, 302C2- Coggon	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
315*. Fluvaquents												
350, 350B----- Waukegan	B	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Moderate.
352B----- Whittier	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
377B, 377C, 377C2- Dinsdale	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
382----- Maxfield	B/D	None-----	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
391B*: Clyde-----	B/D	Frequent----	Very brief	Feb-Nov	1.0-2.5	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Floyd-----	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
398----- Tripoli	B/D	None-----	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
399----- Readlyn	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
407B----- Schley	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	High.
408B, 408C----- Olin	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
412C, 412D, 412F-- Sogn	D	None-----	---	---	>6.0	---	---	4-20	Hard	Moderate	Low-----	Low.
420, 420B----- Tama	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth Ft	Kind	Months	Depth In	Hardness		Uncoated steel	Concrete
426B, 426C----- Aredale	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
428B----- Ely	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
485----- Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.
536----- Hanlon	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jun	>60	---	Moderate	Moderate	Low.
727----- Udolpho	B/D	Rare-----	---	---	1.0-3.0	Apparent	Apr-Jun	>60	---	High-----	Moderate	Moderate.
729B*: Nodaway-----	B	Frequent----	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>60	---	High-----	Moderate	Low.
Radford-----	B	Frequent----	Brief-----	Mar-Jun	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
771B, 771C, 771C2- Waubeeek	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
778, 778B----- Sattre	B	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	High.
782B, 782C2----- Donnan	C	None-----	---	---	2.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
1043----- Bremer	B	Rare-----	---	---	1.0-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
1088----- Nevin	B	Rare-----	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.
1119----- Muscatine	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
1133----- Colo	B/D	Frequent----	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
1160----- Walford	B/D	None-----	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
1291----- Atterberry	B	None-----	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
1485----- Spillville	B	Frequent----	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.
1688----- Koszta	B	Rare-----	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>				
5030*. Pits												
5040*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--CLASSIFICATION OF THE SOILS

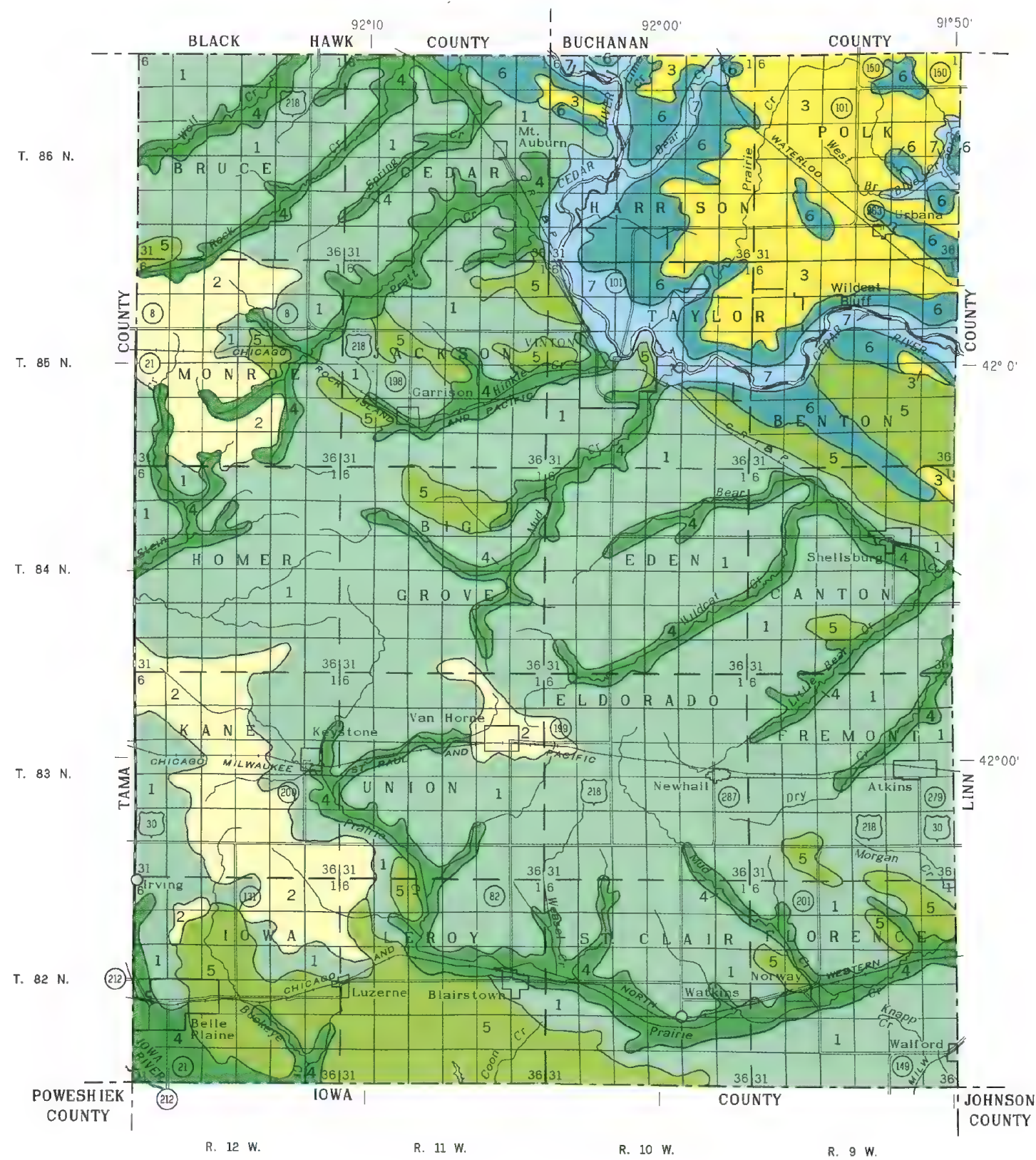
[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aredale-----	Fine-loamy, mixed, mesic Typic Hapludolls
*Atterberry-----	Fine-silty, mixed, mesic Udollic Ochraqualfs
*Backbone-----	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Bassett-----	Fine-loamy, mixed, mesic Mollic Hapludalfs
*Bremer-----	Fine, montmorillonitic, mesic Typic Argiaquolls
Burkhardt-----	Sandy, mixed, mesic Typic Hapludolls
Chelsea-----	Mixed, mesic Alfic Udipsamments
Clyde-----	Fine-loamy, mixed, mesic Typic Haplaquolls
Coggon-----	Fine-loamy, mixed, mesic Typic Hapludalfs
Colo-----	Fine-silty, mixed, mesic Cumulic Haplaquolls
Dickinson-----	Coarse-loamy, mixed, mesic Typic Hapludolls
Dinsdale-----	Fine-silty, mixed, mesic Typic Argiudolls
Donnan-----	Fine-loamy over clayey, mixed, mesic Aquollic Hapludalfs
Downs-----	Fine-silty, mixed, mesic Mollic Hapludalfs
Ely-----	Fine-silty, mixed, mesic Cumulic Hapludolls
Fayette-----	Fine-silty, mixed, mesic Typic Hapludalfs
Finchford-----	Sandy, mixed, mesic Entic Hapludolls
Flagler-----	Coarse-loamy, mixed, mesic Typic Hapludolls
Floyd-----	Fine-loamy, mixed, mesic Aquic Hapludolls
Fluvaquents-----	Sandy and loamy, mixed, nonacid, mesic Fluvaquents
Garwin-----	Fine-silty, mixed, mesic Typic Haplaquolls
Hanlon-----	Coarse-loamy, mixed, mesic Cumulic Hapludolls
Kenyon-----	Fine-loamy, mixed, mesic Typic Hapludolls
Klinger-----	Fine-silty, mixed, mesic Aquic Hapludolls
*Koszta-----	Fine-silty, mixed, mesic Udollic Ochraqualfs
Lamont-----	Coarse-loamy, mixed, mesic Typic Hapludalfs
Lawler-----	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Lindley-----	Fine-loamy, mixed, mesic Typic Hapludalfs
Maxfield-----	Fine-silty, mixed, mesic Typic Haplaquolls
Muscatine-----	Fine-silty, mixed, mesic Aquic Hapludolls
*Nevin-----	Fine-silty, mixed, mesic Aquic Argiudolls
Nodaway-----	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Olin-----	Coarse-loamy, mixed, mesic Typic Hapludolls
Orthents-----	Loamy, mixed, nonacid, mesic Udorthents
*Palms-----	Loamy, mixed, euic, mesic Terric Medisaprists
Radford-----	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Readlyn-----	Fine-loamy, mixed, mesic Aquic Hapludolls
Rockton-----	Fine-loamy, mixed, mesic Typic Argiudolls
Sattre-----	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
Saude-----	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Schley-----	Fine-loamy, mixed, mesic Udollic Ochraqualfs
*Sogn-----	Loamy, mixed, mesic Lithic Haplustolls
Sparta-----	Sandy, mixed, mesic Entic Hapludolls
Sperry-----	Fine, montmorillonitic, mesic Typic Argialbolls
Spillville-----	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tama-----	Fine-silty, mixed, mesic Typic Argiudolls
Tripoli-----	Fine-loamy, mixed, mesic Typic Haplaquolls
Udolpho-----	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Ochraqualfs
*Vesser-----	Fine-silty, mixed, mesic Argiaquic Argialbolls
Walford-----	Fine-silty, mixed, mesic Mollic Ochraqualfs
Waubeeek-----	Fine-silty, mixed, mesic Mollic Hapludalfs
Waukee-----	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Waukegan-----	Fine-silty over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Whalan-----	Fine-loamy, mixed, mesic Typic Hapludalfs
Whittier-----	Fine-silty over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
*Wiota-----	Fine-silty, mixed, mesic Typic Argiudolls
Zook-----	Fine, montmorillonitic, mesic Cumulic Haplaquolls

NRCS Accessibility Statement

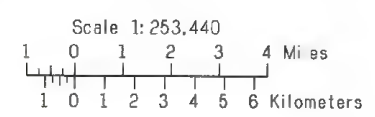
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
IOWA AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
DEPARTMENT OF SOIL CONSERVATION, STATE OF IOWA

GENERAL SOIL MAP BENTON COUNTY, IOWA



SOIL LEGEND*

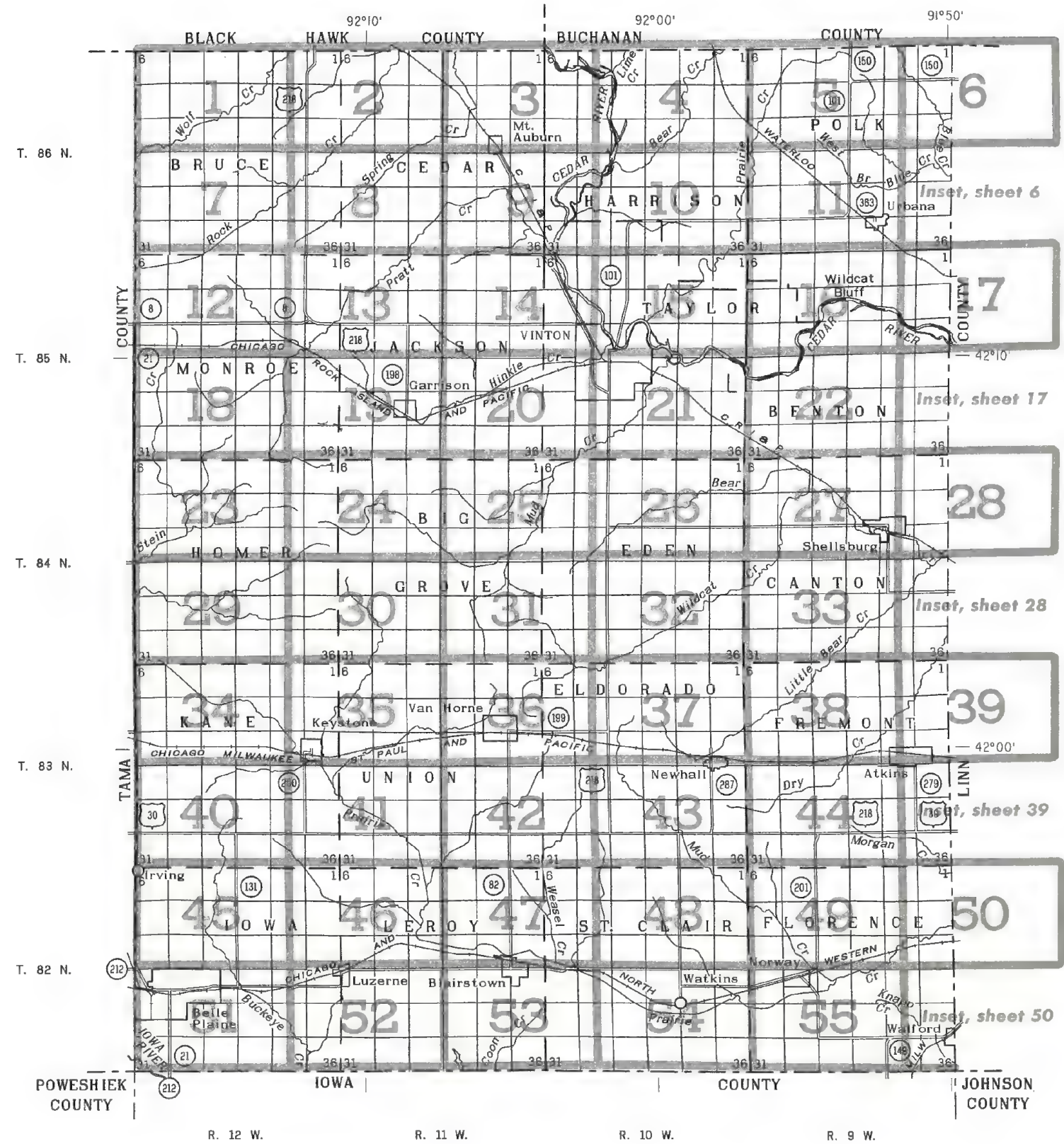
- 1 Dinsdale-Kenyon-Tama association: Nearly level to strongly sloping, well drained and moderately well drained loamy and silty soils; on uplands
- 2 Muscatine-Garwin-Tama association: Nearly level to moderately sloping, well drained to poorly drained silty soils; on uplands
- 3 Kenyon-Clyde-Floyd association: Nearly level to strongly sloping, moderately well drained to poorly drained loamy and silty soils; on uplands
- 4 Colo-Ely-Waukegan association: Nearly level to moderately sloping, well drained to poorly drained silty soils; on bottom lands, stream benches, and foot slopes
- 5 Fayette-Downs association: Gently sloping to very steep, well drained silty soils; on uplands
- 6 Dickinson-Sparta-Chelsea association: Nearly level to very steep, well drained or somewhat excessively drained and excessively drained sandy and loamy soils; on uplands
- 7 Fluvaquents-Spillville-Flagler association: Level to gently sloping, excessively drained to very poorly drained loamy and sandy soils; on bottom lands and stream benches

*The texture given in the descriptive heading refers to the texture of the surface layer of the major soils in each map unit.

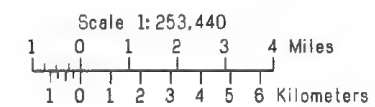
Compiled 1979

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS BENTON COUNTY, IOWA



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Symbols consist of numbers or a combination of numbers and letters; for example, 41, 120, 120B, 163C2, and 1119. The initial number designates the kind of soil or miscellaneous area. A capital letter B, C, D, E, F, or G following a number indicates the class of slope. Symbols without a slope letter are for units that are nearly level or for miscellaneous areas. A final number 2 or 3 following a letter indicates that the soil is moderately eroded or severely eroded, respectively.

SYMBOL	NAME	SYMBOL	NAME
11B	Colo-Ely complex, 2 to 5 percent slopes	178B	Waukee loam, 2 to 5 percent slopes
41	Sparta loamy fine sand, 0 to 2 percent slopes	184B	Klinger silty clay loam, 1 to 4 percent slopes
41B	Sparta loamy fine sand, 2 to 5 percent slopes	198B	Floyd loam, 1 to 4 percent slopes
41C	Sparta loamy fine sand, 5 to 9 percent slopes	207C	Whalan loam, 20 to 30 inches to limestone, 2 to 9 percent slopes
41D	Sparta loamy fine sand, 9 to 14 percent slopes	214C	Rockton loam, 20 to 30 inches to limestone, 2 to 9 percent slopes
51	Vesser silt loam, 0 to 2 percent slopes	220	Nodaway silt loam, 0 to 2 percent slopes
54	Zook silty clay loam, 0 to 2 percent slopes	221B	Palms muck, 1 to 4 percent slopes
63B	Chelsea loamy fine sand, 1 to 5 percent slopes	226	Lawler loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes
63C	Chelsea loamy fine sand, 5 to 9 percent slopes	284	Flagler sandy loam, 0 to 2 percent slopes
63D	Chelsea loamy fine sand, 9 to 18 percent slopes	284B	Flagler sandy loam, 2 to 5 percent slopes
63F	Chelsea loamy fine sand, 18 to 25 percent slopes	285C	Burkhardt sandy loam, 2 to 9 percent slopes
65E2	Lindley loam, 14 to 18 percent slopes, moderately eroded	291	Atterberry silt loam, 1 to 3 percent slopes
65F	Lindley loam, 18 to 25 percent slopes	293C	Chelsea-Lamont-Fayette complex, 5 to 9 percent slopes
65F3	Lindley clay loam, 18 to 25 percent slopes, severely eroded	293D	Chelsea-Lamont-Fayette complex, 9 to 18 percent slopes
83B	Kenyon loam, 2 to 5 percent slopes	293F	Chelsea-Lamont-Fayette complex, 18 to 30 percent slopes
83C	Kenyon loam, 5 to 9 percent slopes	302B	Coggon loam, 2 to 5 percent slopes
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded	302C	Coggon loam, 5 to 9 percent slopes
83D	Kenyon loam, 9 to 14 percent slopes	302C2	Coggon loam, 5 to 9 percent slopes, moderately eroded
83D2	Kenyon loam, 9 to 14 percent slopes, moderately eroded	315	Fluvaquents, sandy and loamy
84	Clyde silty clay loam, 0 to 2 percent slopes	350	Waukegan silt loam, 0 to 2 percent slopes
109C	Backbone fine sandy loam, 4 to 12 percent slopes	350B	Waukegan silt loam, 2 to 5 percent slopes
110B	Lamont fine sandy loam, 2 to 5 percent slopes	352B	Whittier silt loam, 1 to 4 percent slopes
110C	Lamont fine sandy loam, 5 to 9 percent slopes	377B	Dinsdale silty clay loam, 2 to 5 percent slopes
118	Garwin silty clay loam, 0 to 2 percent slopes	377C	Dinsdale silty clay loam, 5 to 9 percent slopes
119	Muscatine silty clay loam, 0 to 2 percent slopes	377C2	Dinsdale silty clay loam, 5 to 9 percent slopes, moderately eroded
119B	Muscatine silty clay loam, 2 to 5 percent slopes	382	Maxfield silty clay loam, 0 to 2 percent slopes
120	Tama silty clay loam, 0 to 2 percent slopes	391B	Clyde-Floyd complex, 1 to 4 percent slopes
120B	Tama silty clay loam, 2 to 5 percent slopes	398	Tripoli clay loam, 0 to 2 percent slopes
120C	Tama silty clay loam, 5 to 9 percent slopes	399	Readlyn loam, 1 to 3 percent slopes
120C2	Tama silty clay loam, 5 to 9 percent slopes, moderately eroded	407B	Schley loam, 1 to 4 percent slopes
122	Sperry silt loam, 0 to 1 percent slopes	408B	Olin fine sandy loam, 2 to 5 percent slopes
127	Wiota silt loam, loamy substratum, 1 to 3 percent slopes	408C	Olin fine sandy loam, 5 to 9 percent slopes
133	Colo silty clay loam, 0 to 2 percent slopes	412C	Sogn loam, 5 to 9 percent slopes
159	Finchford loamy sand, 0 to 2 percent slopes	412D	Sogn loam, 9 to 18 percent slopes
162B	Downs silt loam, 2 to 5 percent slopes	412F	Sogn loam, 18 to 40 percent slopes
162C	Downs silt loam, 5 to 9 percent slopes	420	Tama silty clay loam, benches, 0 to 2 percent slopes
162C2	Downs silt loam, 5 to 9 percent slopes, moderately eroded	420B	Tama silty clay loam, benches, 2 to 5 percent slopes
162D	Downs silt loam, 9 to 14 percent slopes	426B	Aredale loam, 2 to 5 percent slopes
162D2	Downs silt loam, 9 to 14 percent slopes, moderately eroded	426C	Aredale loam, 5 to 9 percent slopes
163B	Fayette silt loam, 2 to 5 percent slopes	428B	Ely silt loam, 2 to 5 percent slopes
163C	Fayette silt loam, 5 to 9 percent slopes	485	Spillville loam, 0 to 2 percent slopes
163C2	Fayette silt loam, 5 to 9 percent slopes, moderately eroded	536	Hanlon fine sandy loam, 0 to 2 percent slopes
163D	Fayette silt loam, 9 to 14 percent slopes	727	Udolpho loam, 32 to 40 inches to sand or gravel, 0 to 2 percent slopes
163D2	Fayette silt loam, 9 to 14 percent slopes, moderately eroded	729B	Nodaway-Radford silt loams, 2 to 5 percent slopes
163E	Fayette silt loam, 14 to 18 percent slopes	771B	Waubeeek silt loam, 2 to 5 percent slopes
163E2	Fayette silt loam, 14 to 18 percent slopes, moderately eroded	771C	Waubeeek silt loam, 5 to 9 percent slopes
163F	Fayette silt loam, 18 to 25 percent slopes	771C2	Waubeeek silt loam, 5 to 9 percent slopes, moderately eroded
163F2	Fayette silt loam, 18 to 25 percent slopes, moderately eroded	778	Sattre loam, 0 to 2 percent slopes
163G	Fayette silt loam, 25 to 40 percent slopes	778B	Sattre loam, 2 to 5 percent slopes
171B	Bassett loam, 2 to 5 percent slopes	782B	Donnan silt loam, 2 to 5 percent slopes
171C	Bassett loam, 5 to 9 percent slopes	782C2	Donnan silt loam, 5 to 9 percent slopes, moderately eroded
171C2	Bassett loam, 5 to 9 percent slopes, moderately eroded	1043	Bremer silty clay loam, sandy substratum, 0 to 2 percent slopes
171D	Bassett loam, 9 to 14 percent slopes	1088	Nevin silty clay loam, sandy substratum, 0 to 2 percent slopes
171D2	Bassett loam, 9 to 14 percent slopes, moderately eroded	1119	Muscatine silty clay loam, benches, 0 to 2 percent slopes
175	Dickinson fine sandy loam, 0 to 2 percent slopes	1133	Colo silty clay loam, channeled, 0 to 2 percent slopes
175B	Dickinson fine sandy loam, 2 to 5 percent slopes	1160	Walford silt loam, sandy substratum, 0 to 1 percent slopes
175C	Dickinson fine sandy loam, 5 to 9 percent slopes	1291	Atterberry silt loam, benches, 0 to 2 percent slopes
177	Saude loam, 0 to 2 percent slopes	1485	Spillville loam, channeled, 0 to 2 percent slopes
177B	Saude loam, 2 to 5 percent slopes	1688	Koszta silt loam, loamy substratum, 0 to 2 percent slopes
177C	Saude loam, 5 to 9 percent slopes	5030	Pits, quarries
178	Waukee loam, 0 to 2 percent slopes	5040	Orthents, loamy

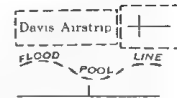
CONVENTIONAL AND SPECIAL
SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province	— — — — —
County or parish	— — — — —
Minor civil division	— — — — —
Reservation (national forest or park, state forest or park, and large airport)	— . — — — — —
Land grant	— — — — —
Limit of soil survey (label)	— — — — —
Field sheet matchline & neatline	— — — — —

AD HOC BOUNDARY (label)



Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK



LAND DIVISION CORNERS
(sections and land grants)



ROADS

Divided (median shown if scale permits)	— — — — —
Other roads	— — — — —
Trail	- - - - -

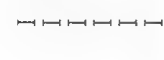
ROAD EMBLEMS & DESIGNATIONS

Interstate	
Federal	
State	
County, farm or ranch	

RAILROAD



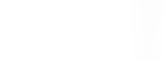
POWER TRANSMISSION LINE
(normally not shown)



PIPE LINE
(normally not shown)



FENCE
(normally not shown)



LEVEES

Without road	— — — — —
With road	— — — — —
With railroad	— — — — —

DAMS

Large (to scale)	
Medium or small	

PITS

Gravel pit	
Mine or quarry	

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)	■
Church	✠
School	✎
Indian mound (label)	Indian Mound
Located object (label)	Tower
Tank (label)	GAS
Wells, oil or gas	⊙
Windmill	⊙
Kitchen midden	⊙

WATER FEATURES

DRAINAGE

Perennial, double line	
Perennial, single line	

Intermittent

Crossable with tillage implements	
Not crossable with tillage implements	

Drainage end



Canals or ditches

Double-line (label)	CANAL
Drainage and/or irrigation	

LAKES, PONDS AND RESERVOIRS

Perennial	
Intermittent	

MISCELLANEOUS WATER FEATURES

Marsh or swamp	
Spring	
Well, artesian	
Well, irrigation	
Wet spot	

SPECIAL SYMBOLS FOR
SOIL SURVEY

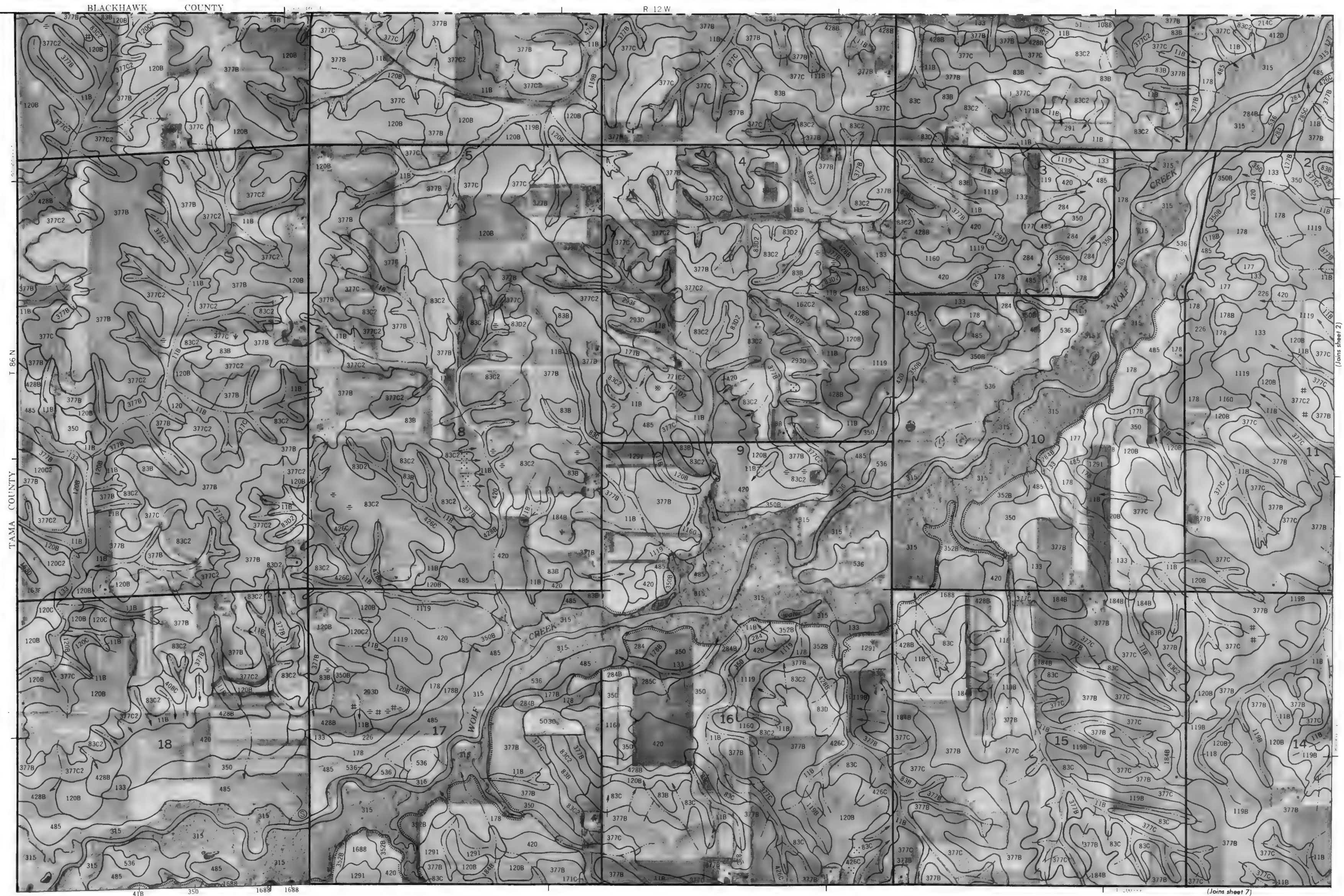
SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS	
Bedrock (points down slope)	~~~~~
Other than bedrock (points down slope)	~~~~~
SHORT STEEP SLOPE	~~~~~
GULLY	~~~~~
DEPRESSION OR SINK	⊙
SOIL SAMPLE SITE (normally not shown)	⊙
MISCELLANEOUS	
Blowout	⊙
Clay spot	⊙
Gravelly spot	⊙
Gumbo, slick or scabby spot (sodic)	⊙
Dumps and other similar non soil areas	⊙
Prominent hill or peak	⊙
Rock outcrop (includes sandstone and shale)	⊙
Saline spot	⊙
Sandy spot	⊙
Severely eroded spot	⊙
Slide or slip (tips point upslope)	⊙
Stony spot, very stony spot	⊙
Calcareous spot	⊙
Muck spot	⊙
Made land spot	⊙
Glacial till spot	⊙

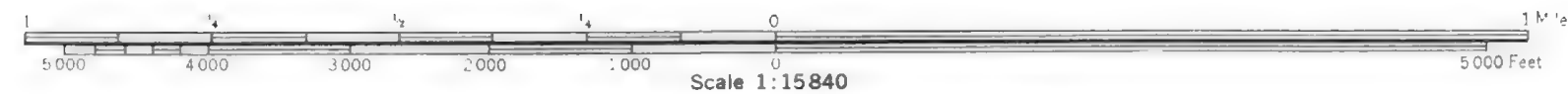
BENTON COUNTY, IOWA - SHEET NUMBER 1



BENTON COUNTY, IOWA NO. 1



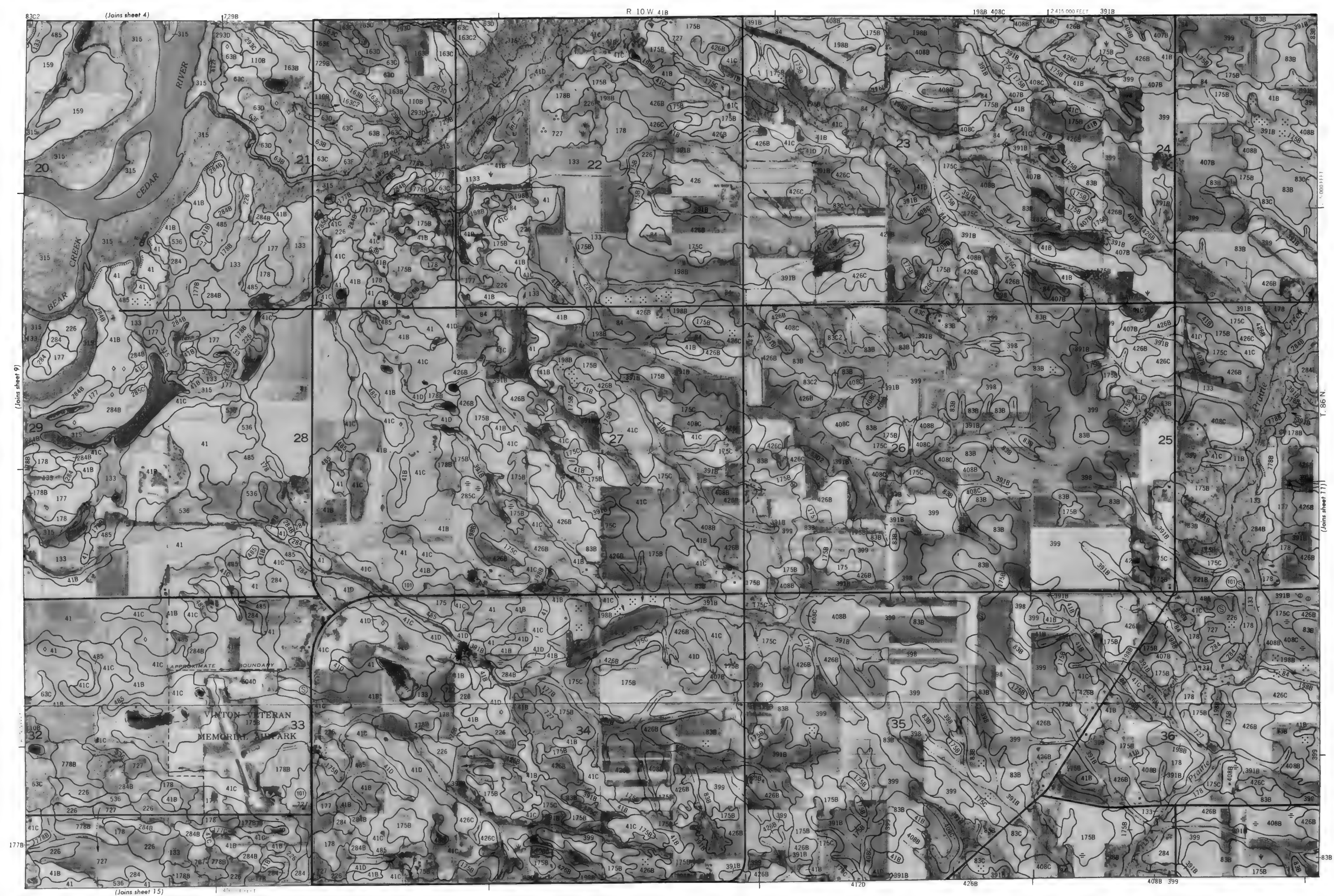
Copyright 1967 by the Iowa Department of Transportation
Revised 1967 by the Iowa Department of Transportation
One of a series of maps of Benton County, Iowa



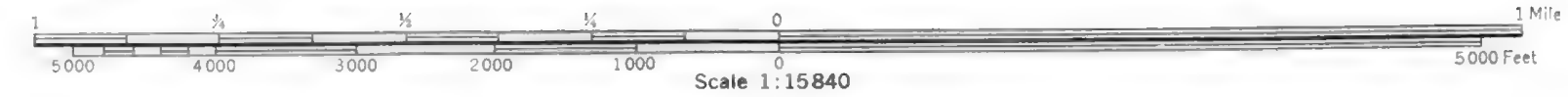
(Joins sheet 7)



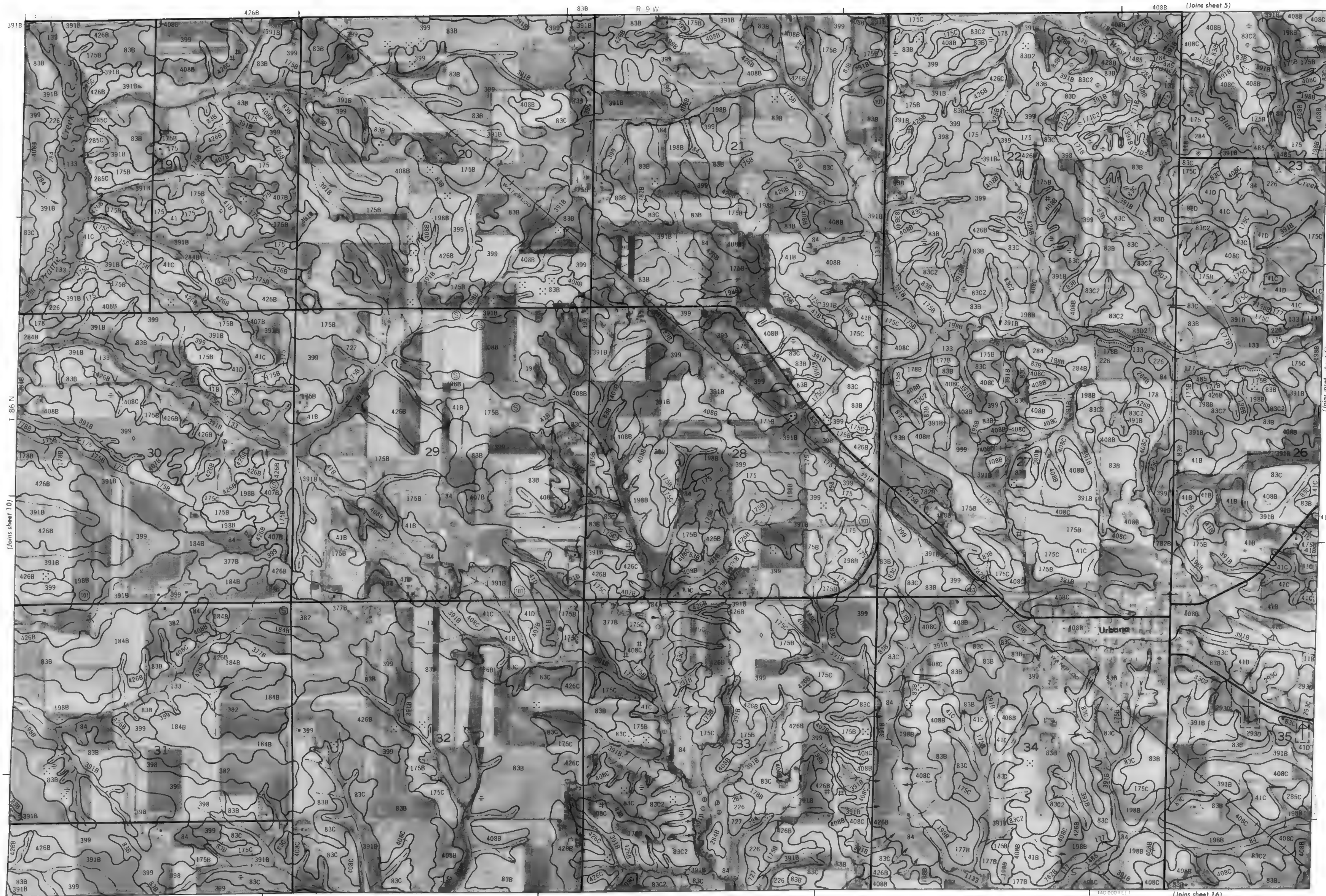
BENTON COUNTY, IOWA - SHEET NUMBER 10



This map is based on 1969 aerial photography
and is a Department of Agriculture
interpretation of the original data.



Hand note and tick mark and corner
corners are approximately positioned



1:15840
1 inch = 1320 feet
1 mile = 63,360 feet

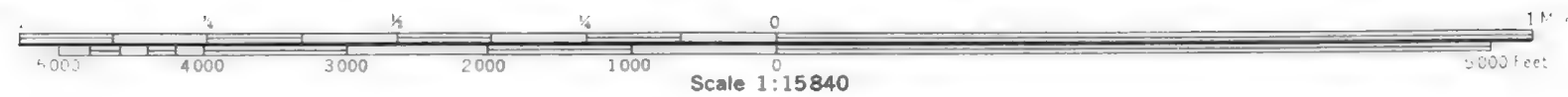
(Joins sheet 16)

(Joins sheet 6)

(Joins sheet 10)

(Joins sheet 5)

BENTON COUNTY, IOWA NO. 11

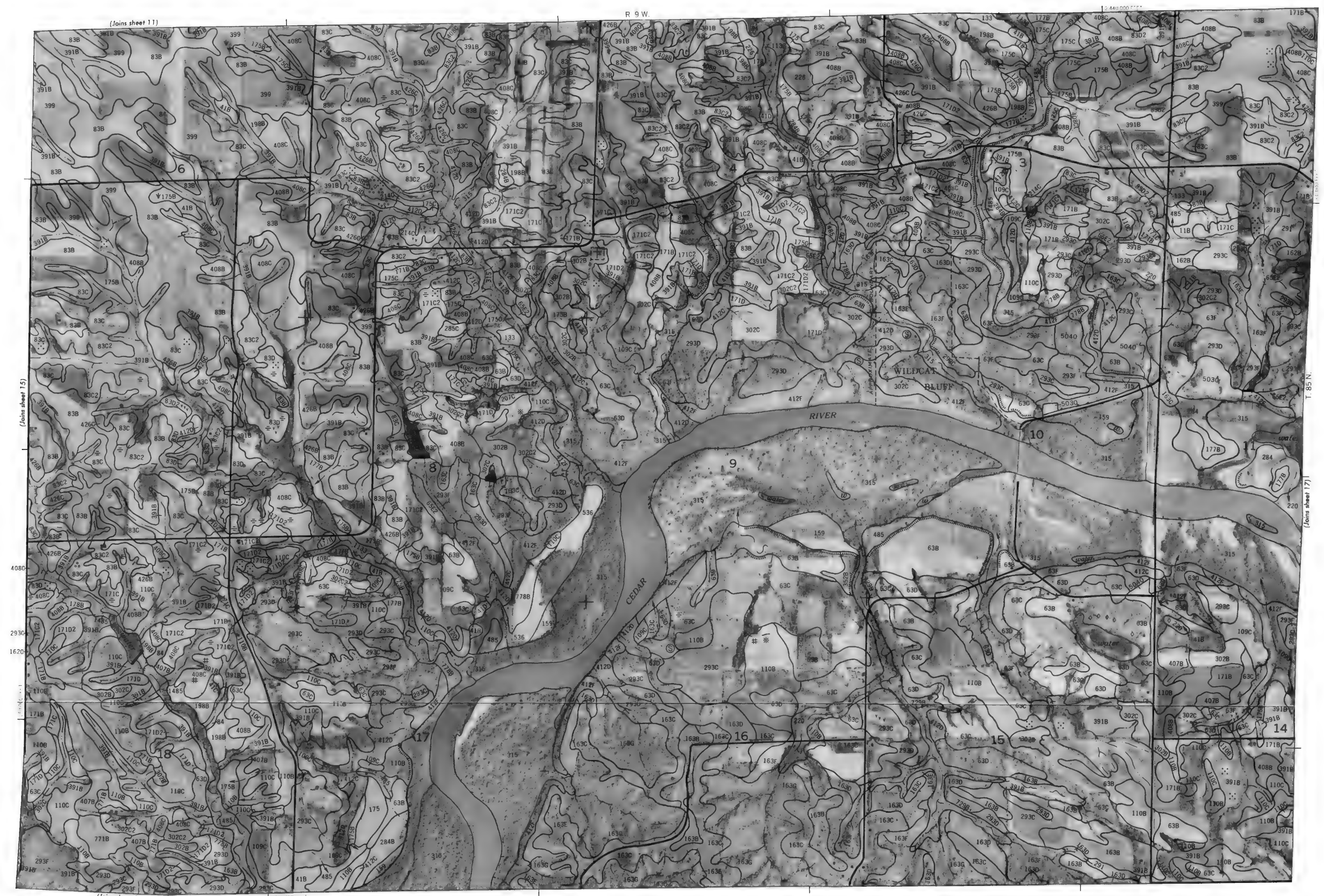


BENTON COUNTY, IOWA - SHEET NUMBER 14

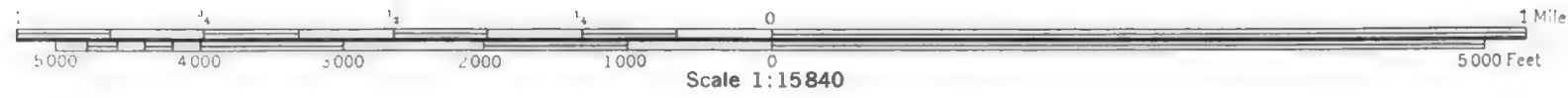




BENTON COUNTY, IOWA - SHEET NUMBER 16



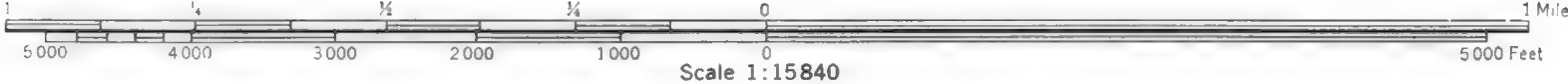
This map is a reproduction of the original map as shown to the Department of Agriculture, U.S. Department of the Interior, and the U.S. Geological Survey. It is not a legal document and should not be used for legal purposes.



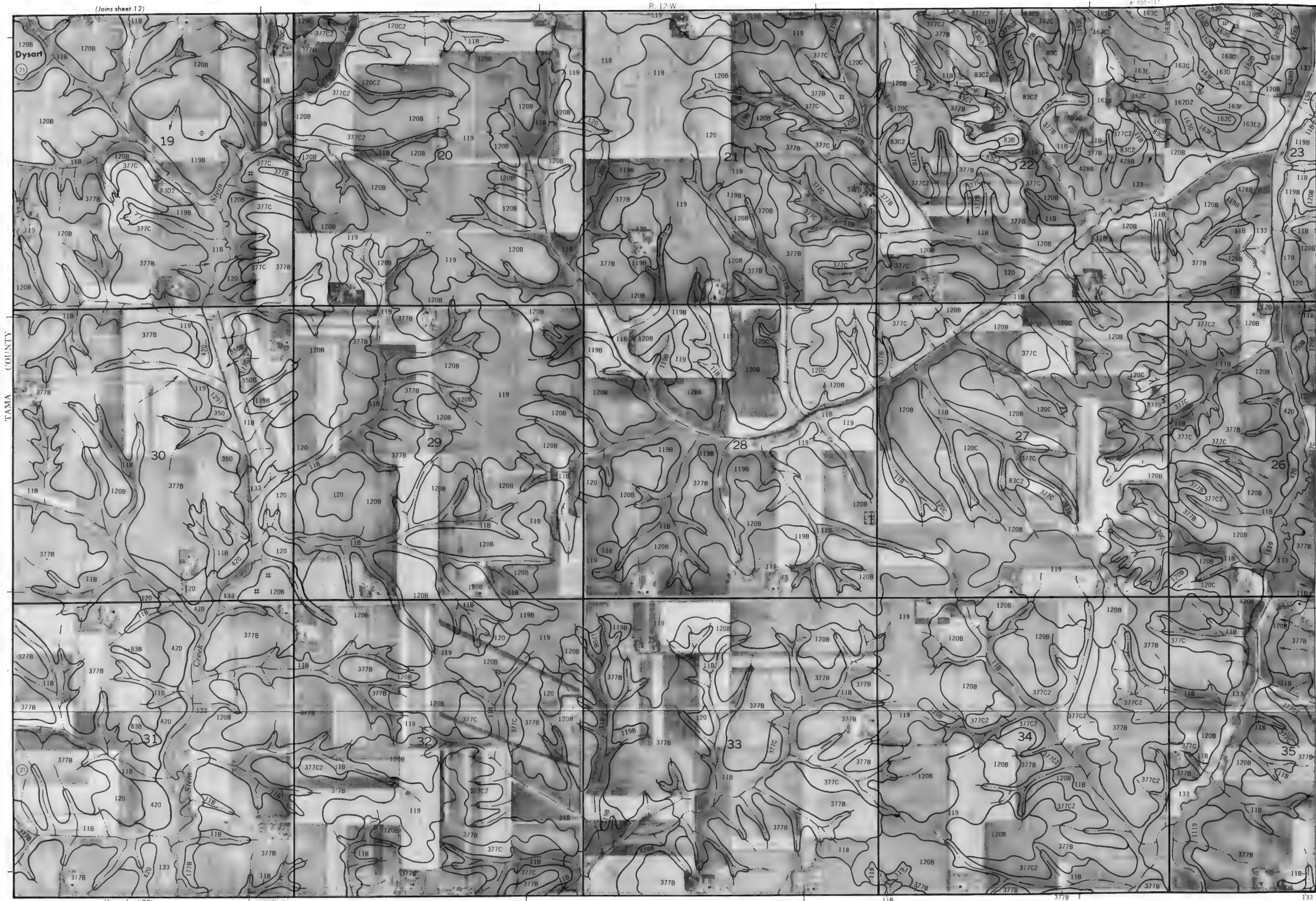
Contour lines and spot elevations are approximate. Spot elevations are indicated by numbers.



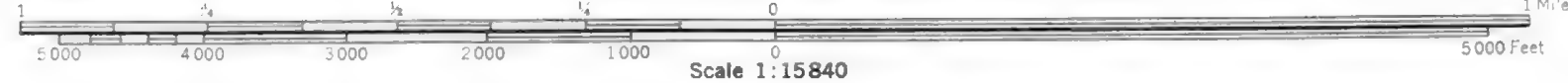
This map is compiled on 1969 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



Coordinate grid ticks and land division corners are approximately positioned.



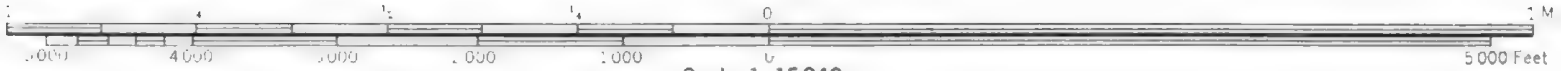
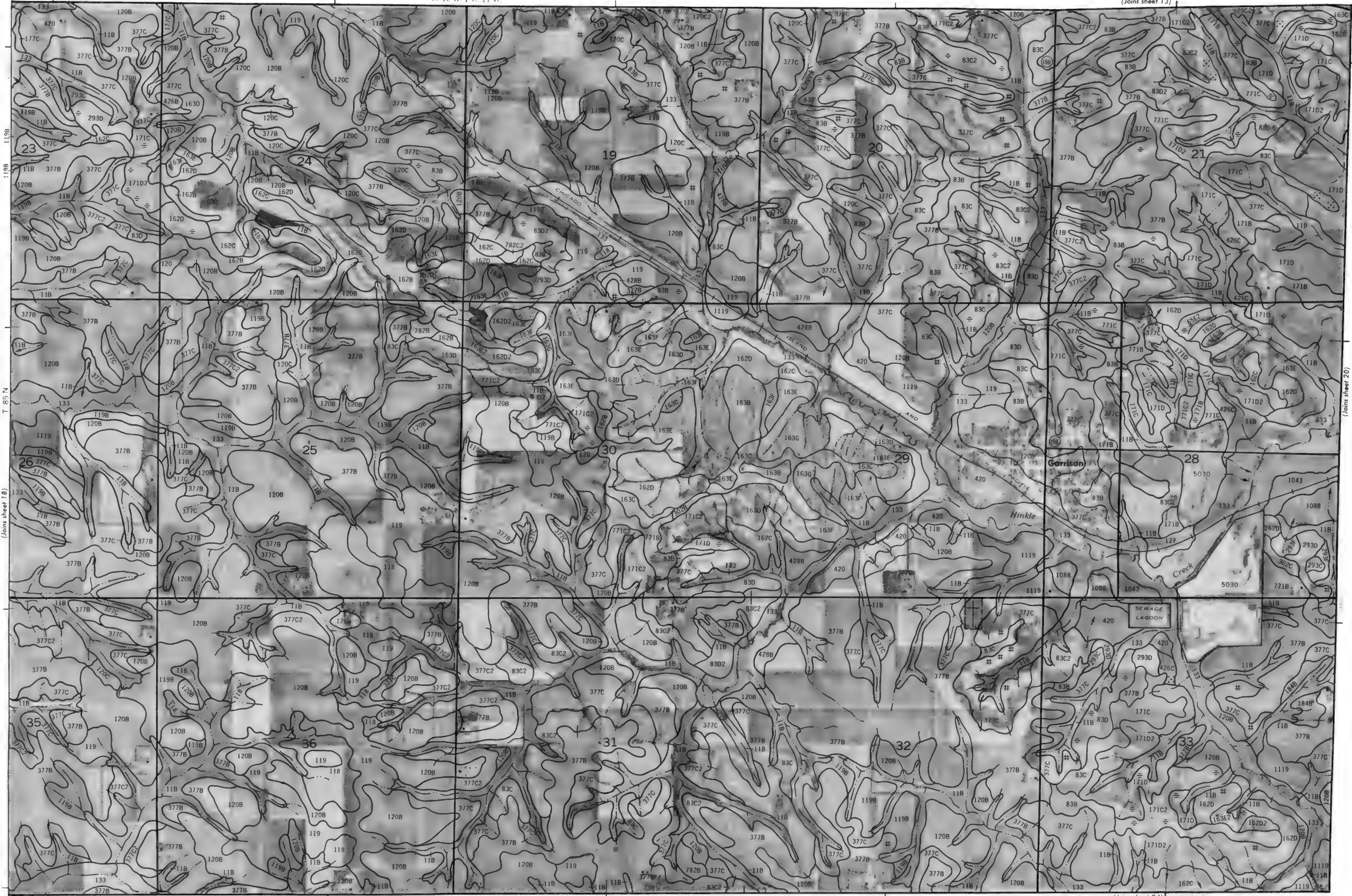
Compiled on 1969 aerial photography
by the U.S. Department of Agriculture, Soil
Conservation Service and cooperating agencies



Coordinate and section numbers
corners are approximate

R. 12 W. | R. 11 W.

(Joins sheet 13)

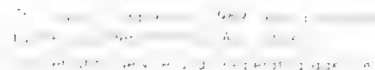


Scale 1:15840



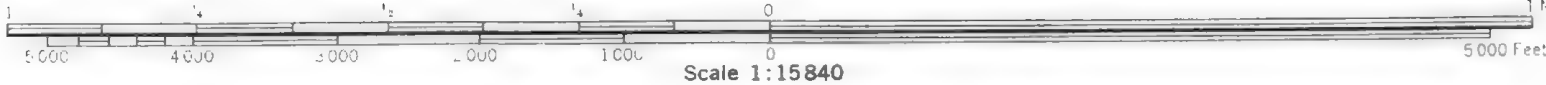
1.86N

(Join sheet 3)





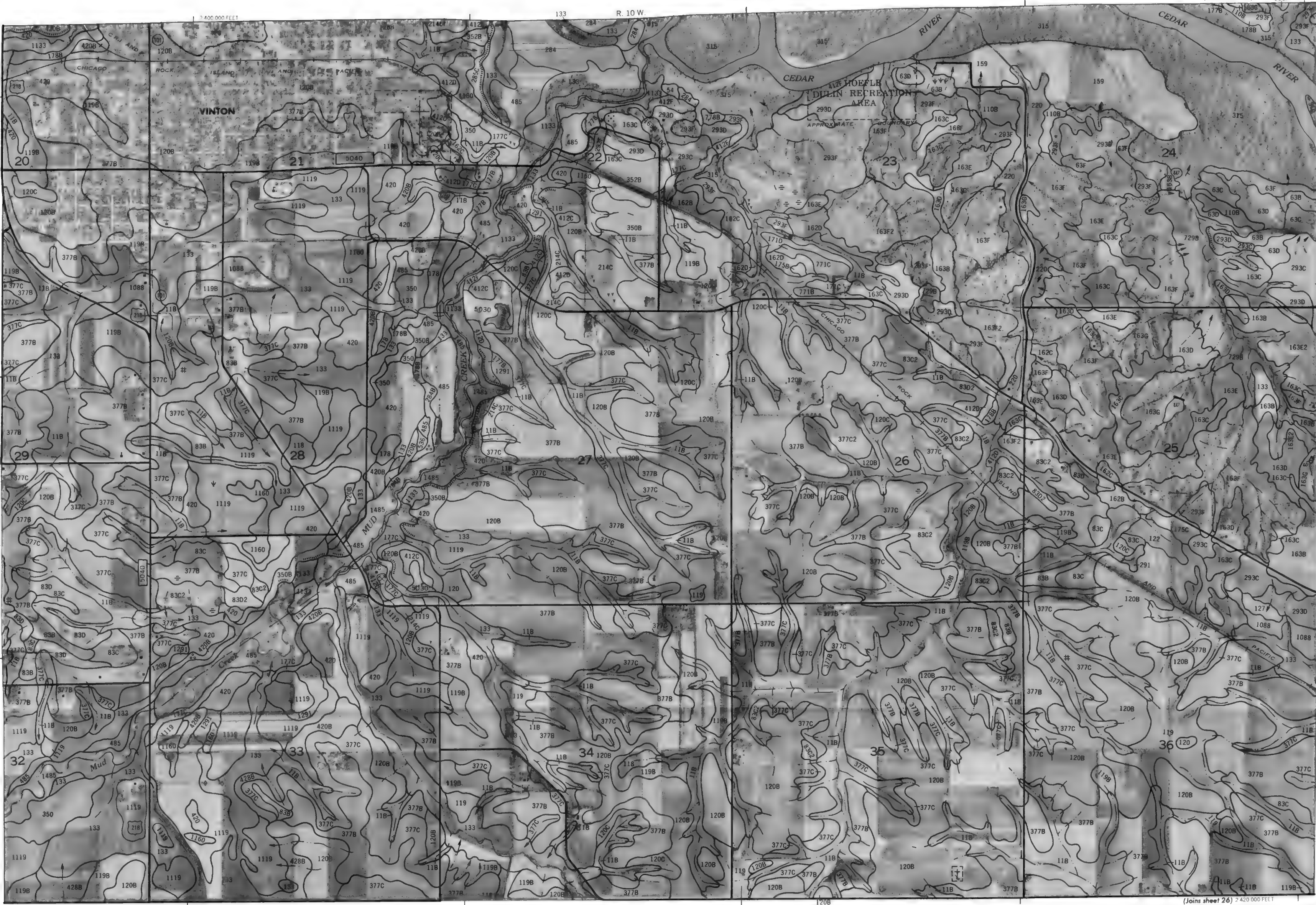
BENTON COUNTY, IOWA - SHEET NUMBER 20



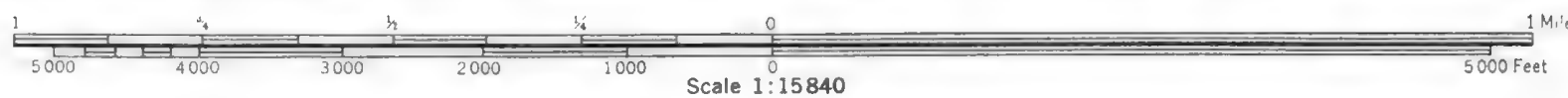
Scale 1:15840

(Joins sheet 15)

(Joins sheet 26)



This map is compiled on 1969 aerial photography.
overlaid on Department of Agriculture Soil
Conservation Service and USGS maps.



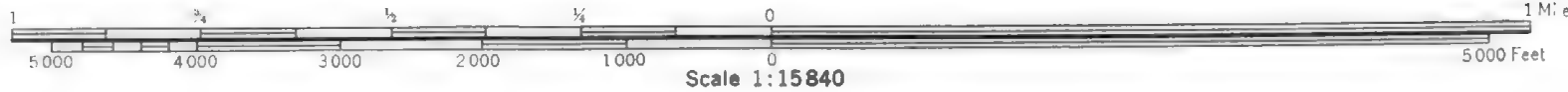
Section grid ticks and area division
corners are approximately positioned.



BENTON COUNTY, IOWA - SHEET NUMBER 22

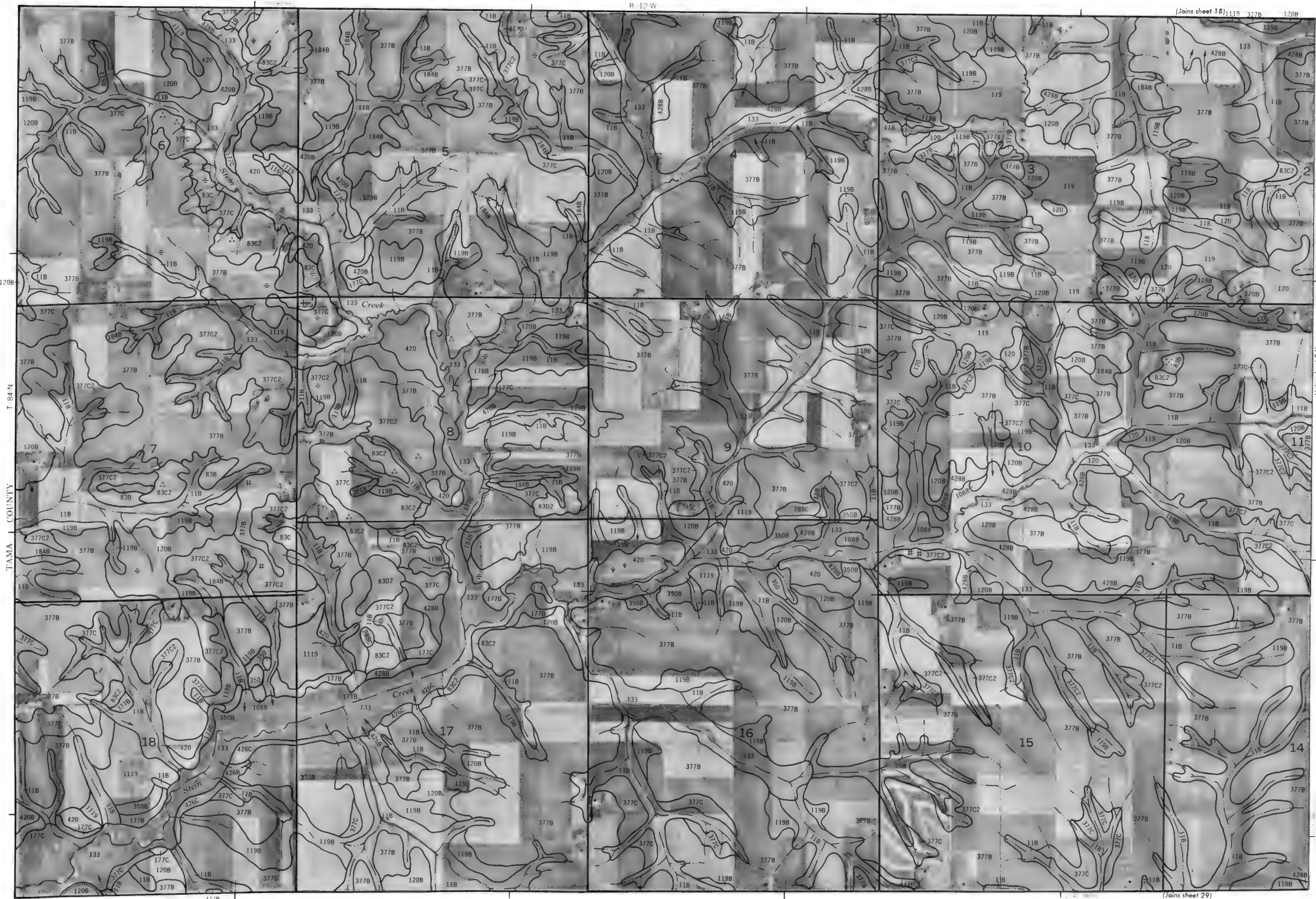


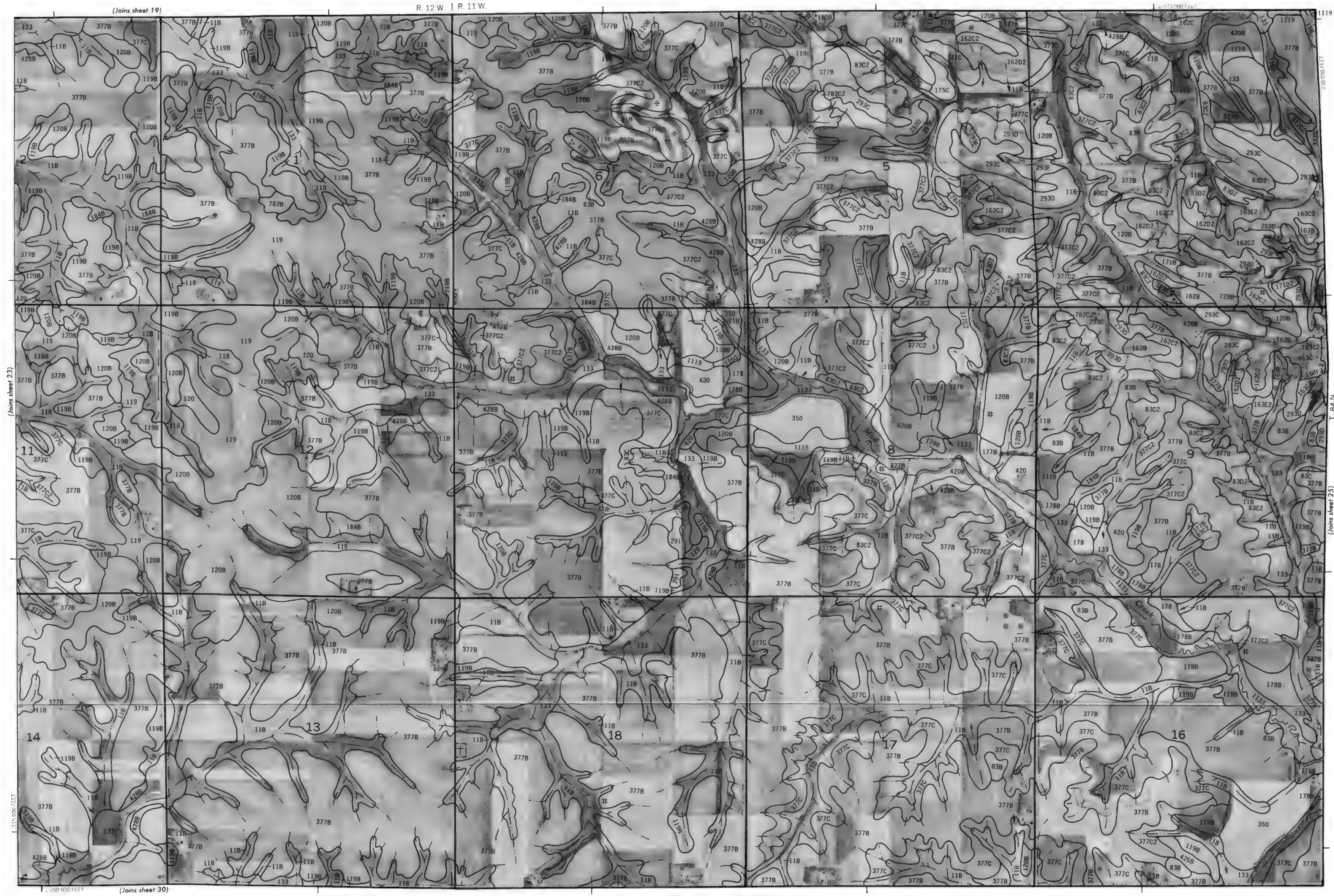
This map is compiled on 1969 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



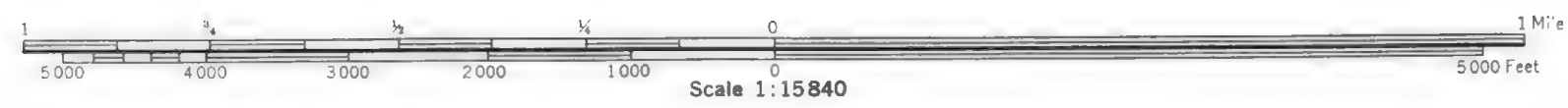
Legend: solid line and dots indicate
new data; dashed line and dots indicate
old data.

BENTON COUNTY, IOWA NO. 23





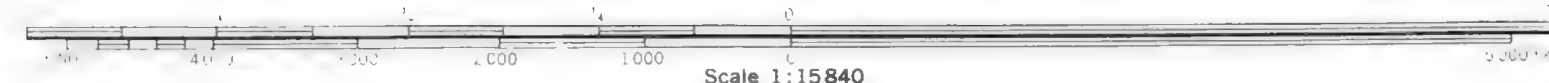
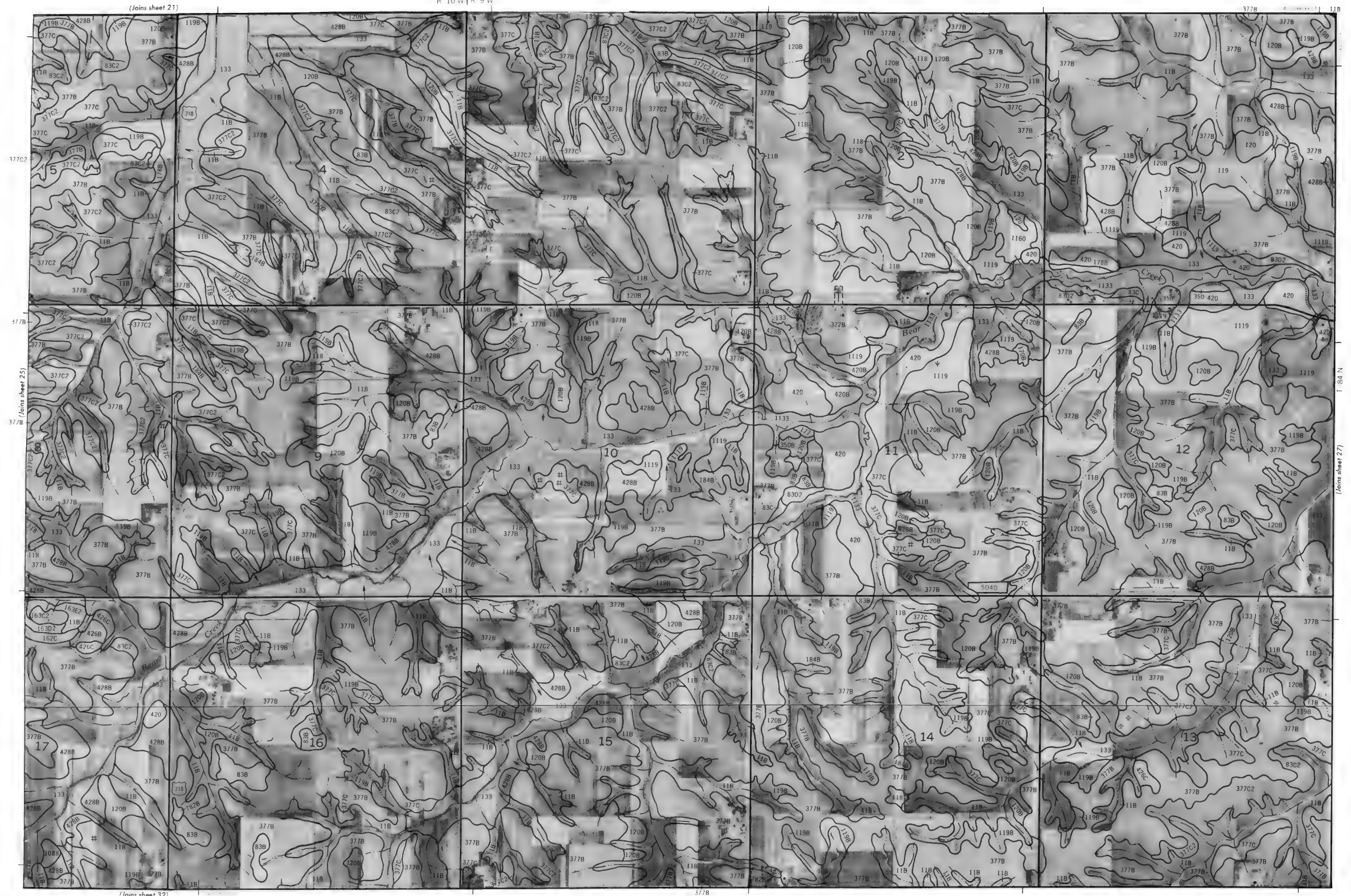
This map is compiled from 969 aerial photographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

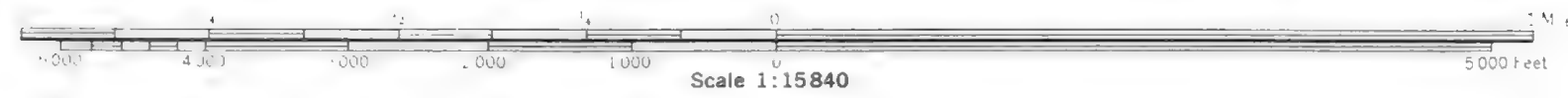
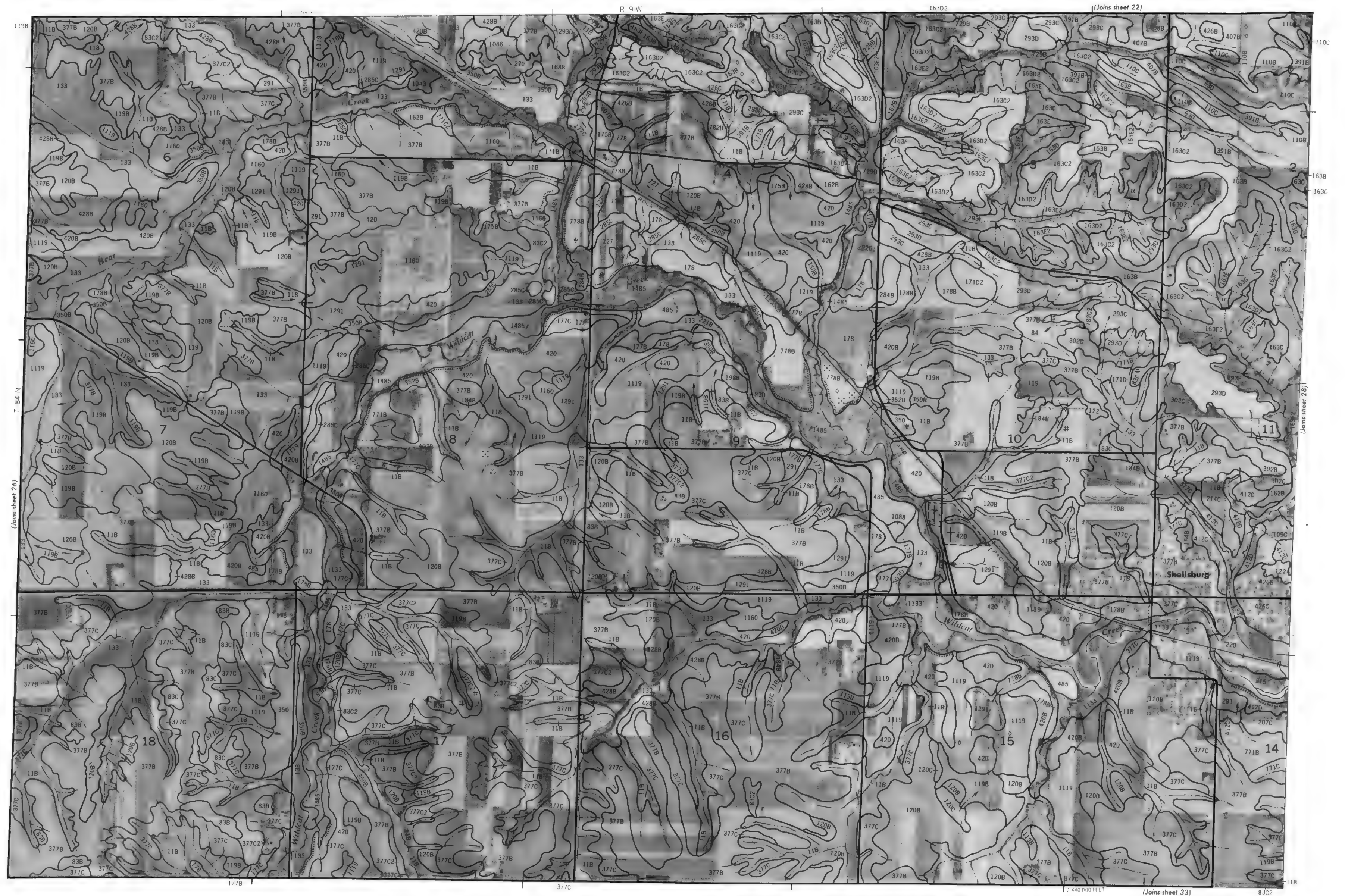


Coordinate grid ticks and land division corners are approximately positioned



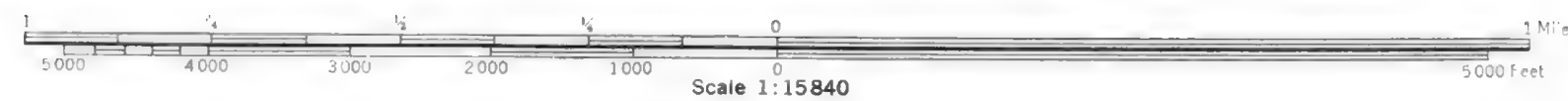
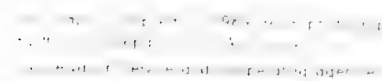
R 10 W | R 9 W





Scale 1:15840

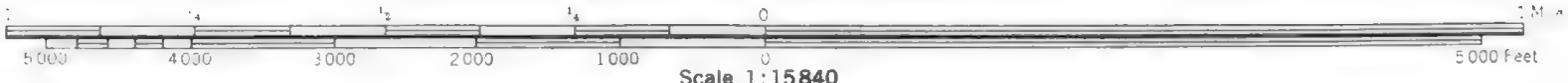
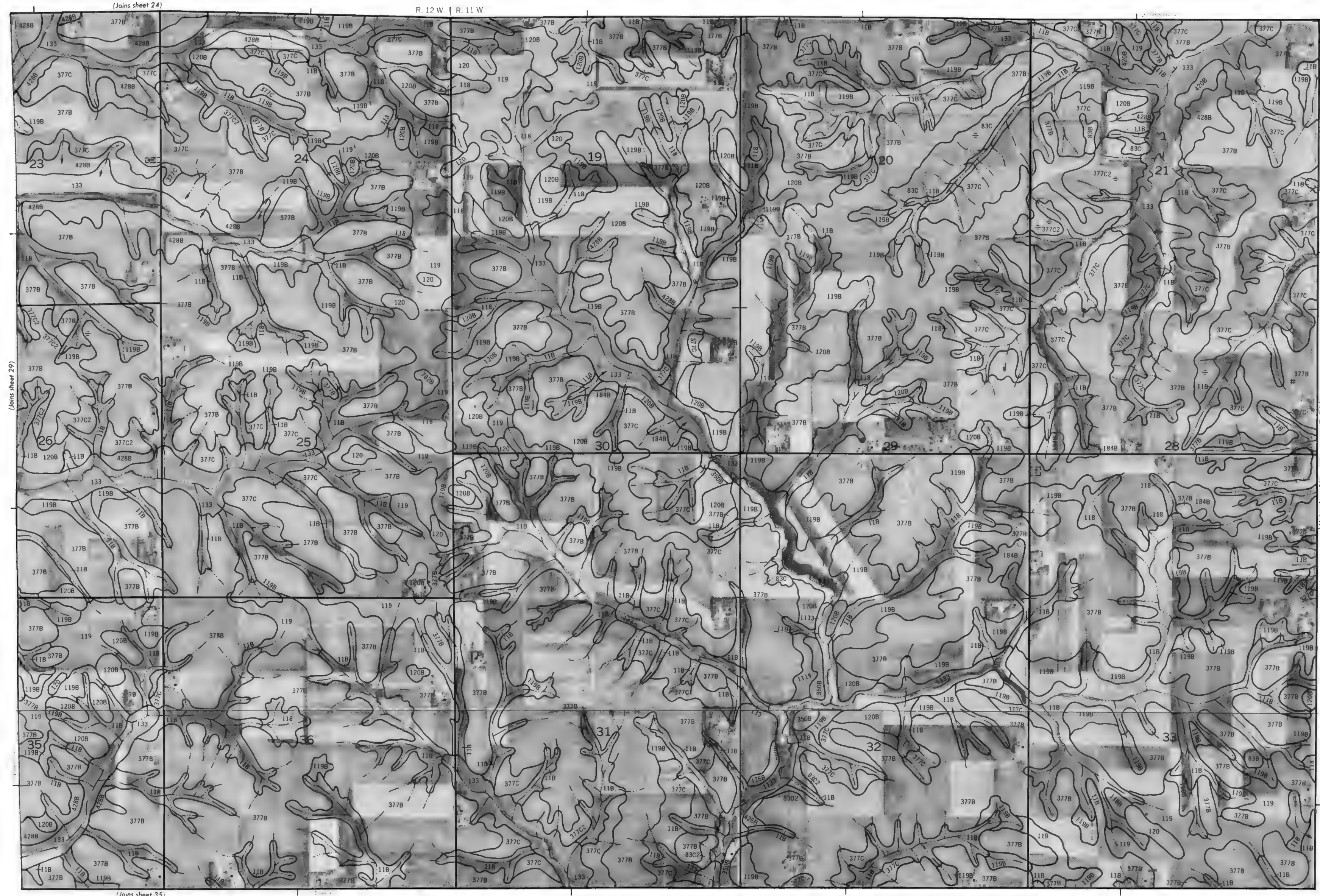
BENTON COUNTY, IOWA NO. 28



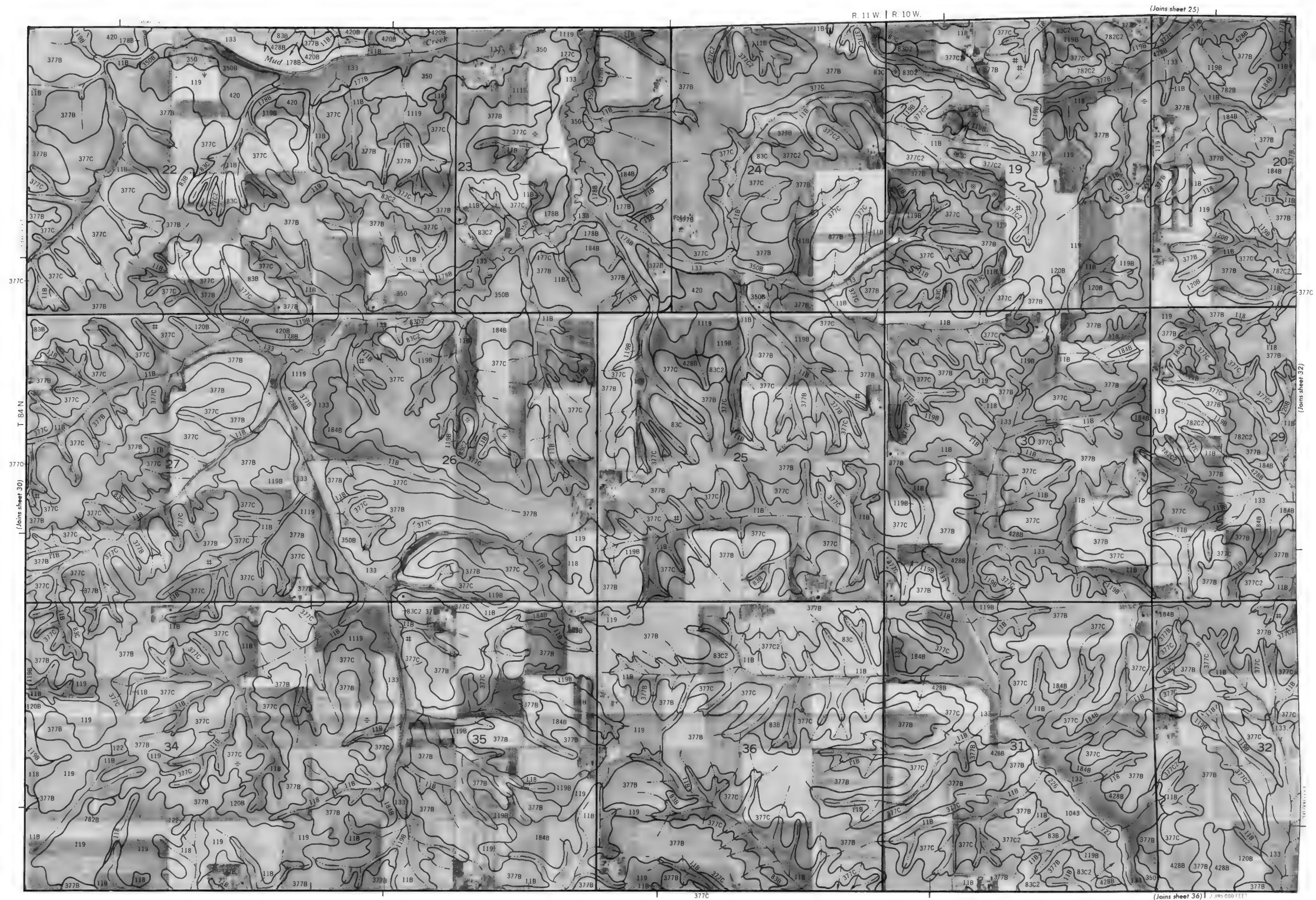
BENTON COUNTY, IOWA - SHEET NUMBER 30

30

N



BENTON COUNTY, IOWA NO. 30



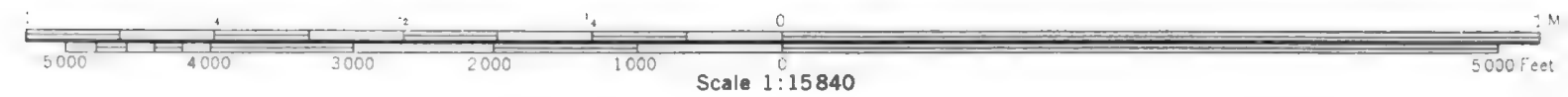
R. 11 W. | R. 10 W.

(Joins sheet 25)

(Joins sheet 30)

(Joins sheet 32)

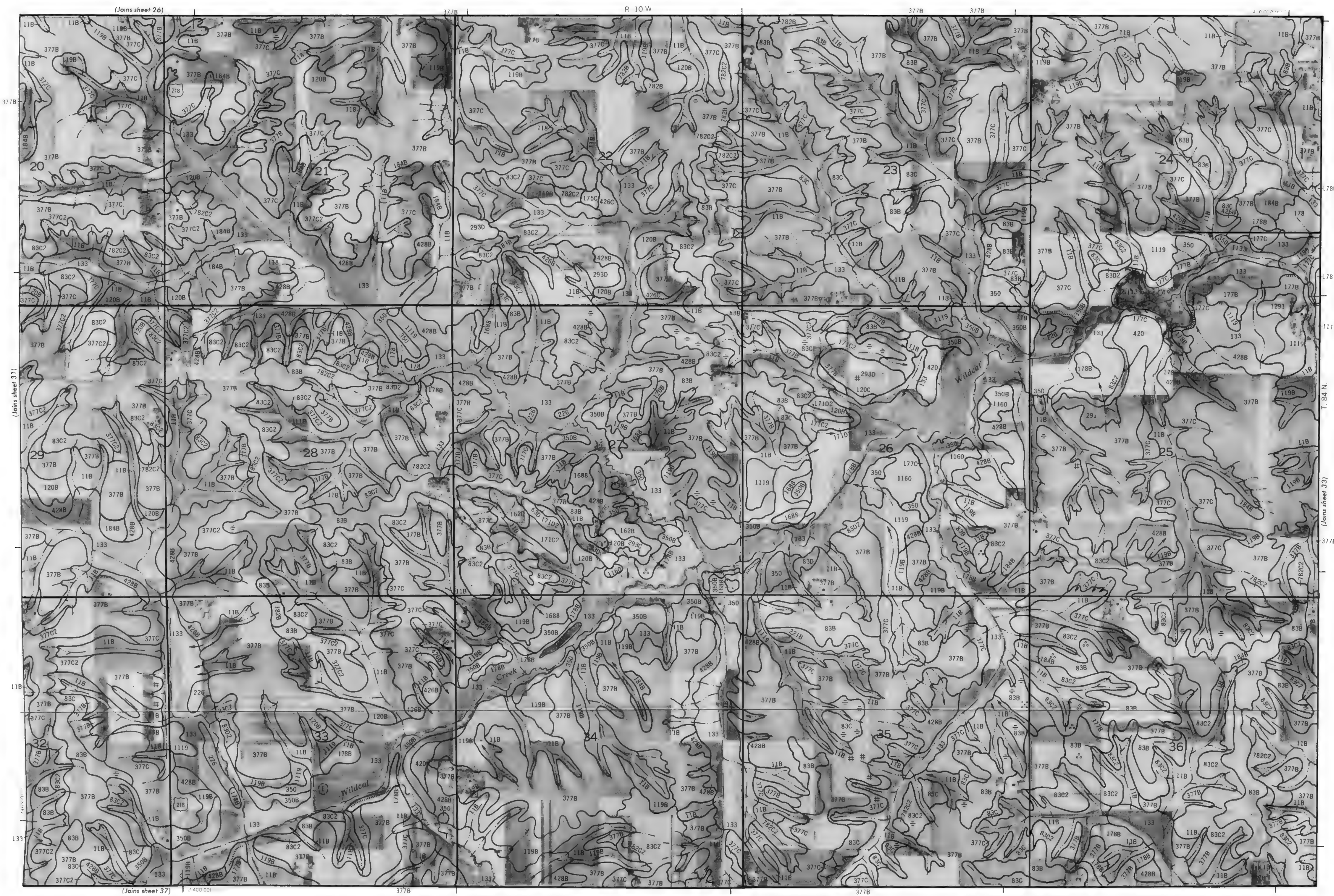
(Joins sheet 36) 1 395 000 FEE



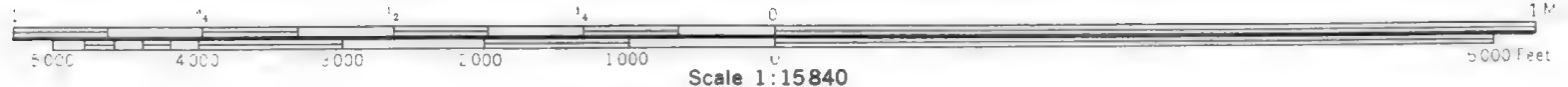
BENTON COUNTY, IOWA NO. 31



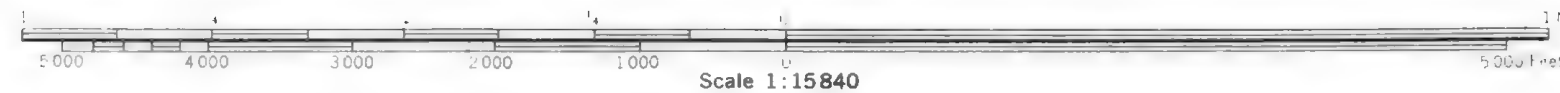
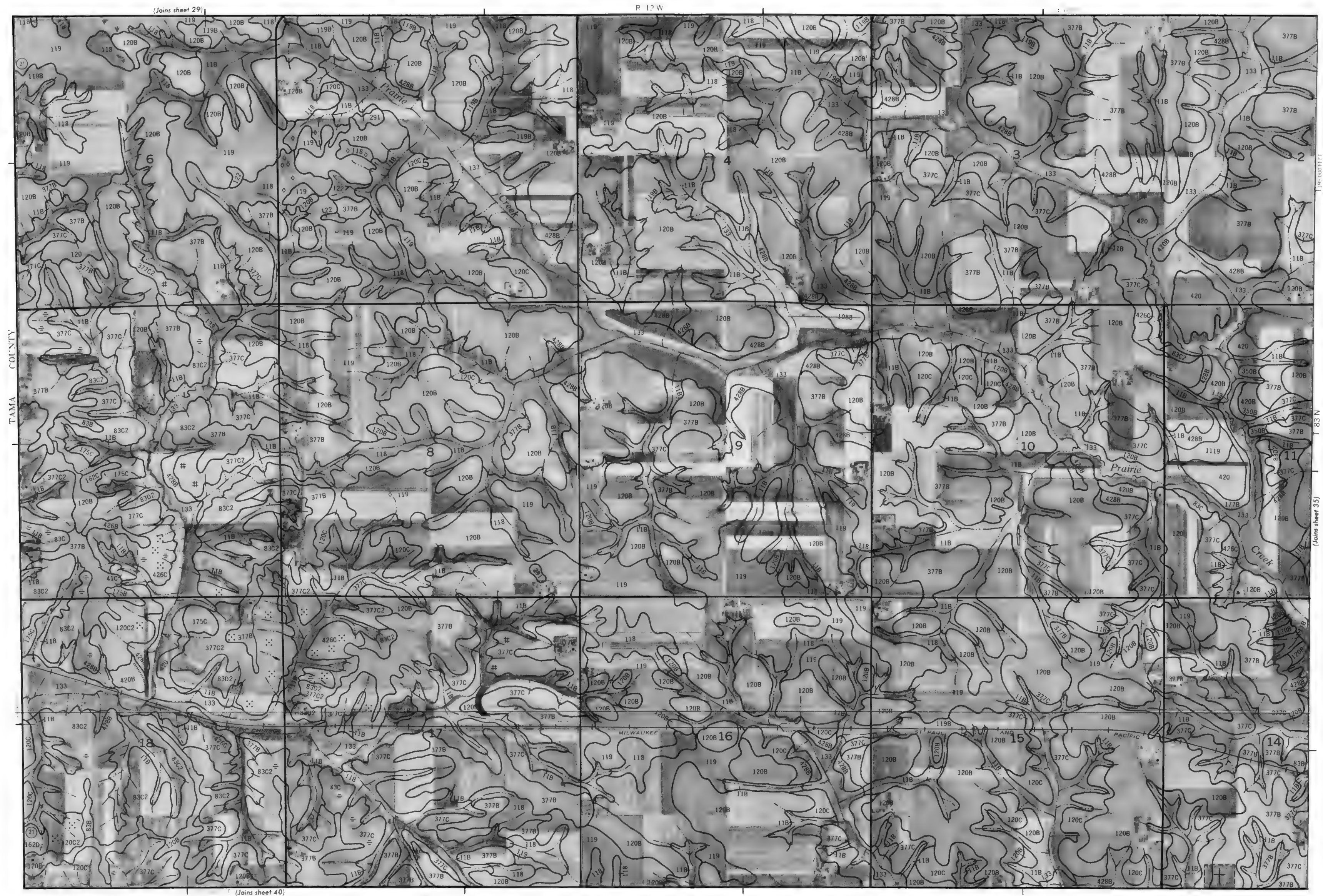
BENTON COUNTY, IOWA - SHEET NUMBER 32



1. Contour interval 20 feet
2. Section numbers
3. Township and Range numbers
4. Section corners and quarter section corners



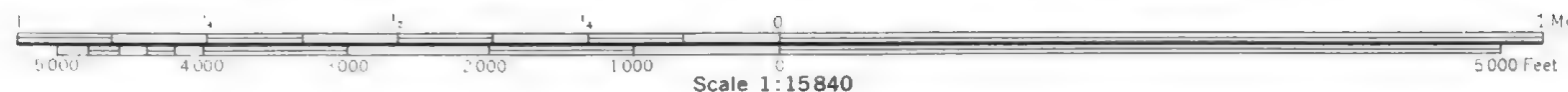
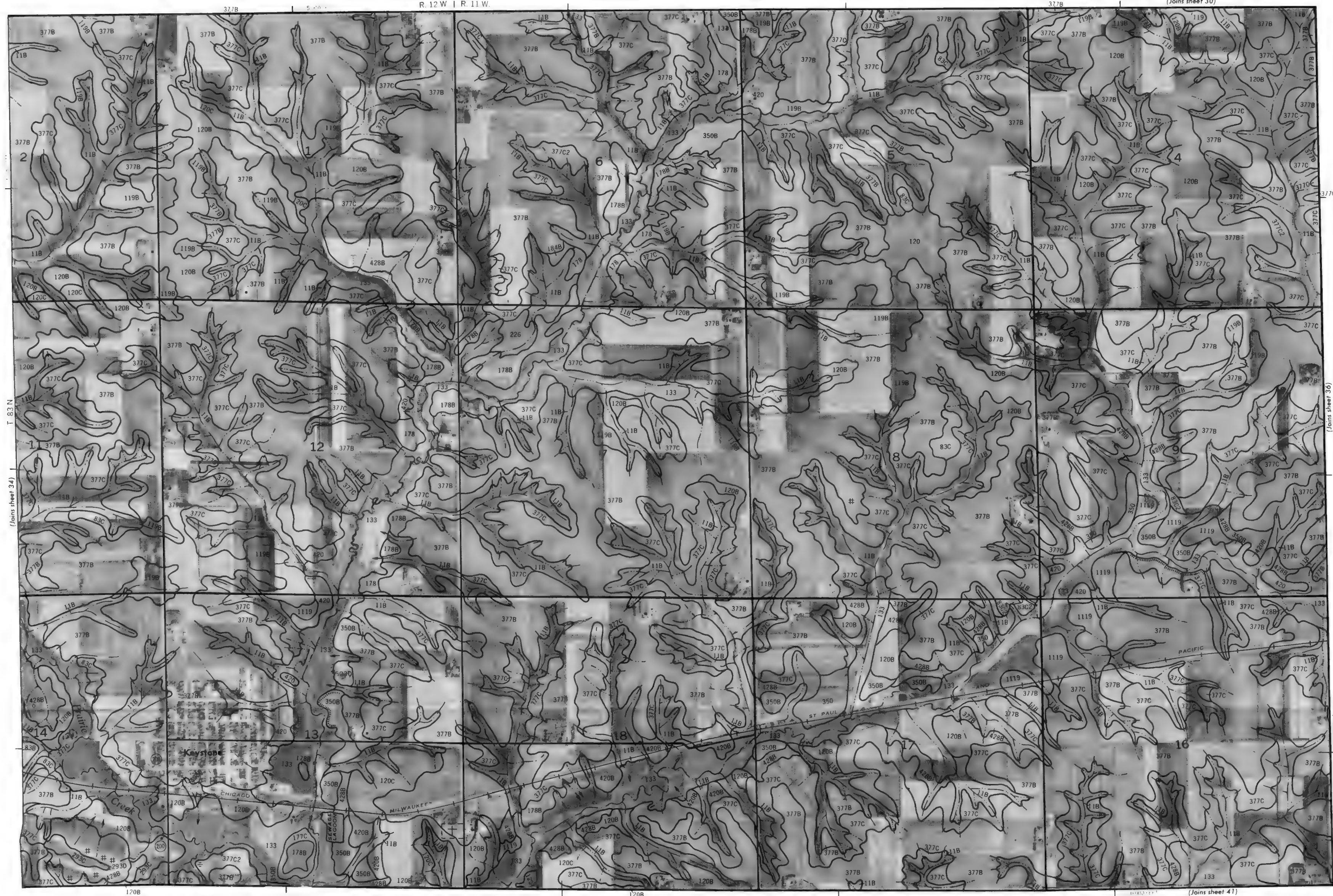
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R. 12 W. | R. 11 W.

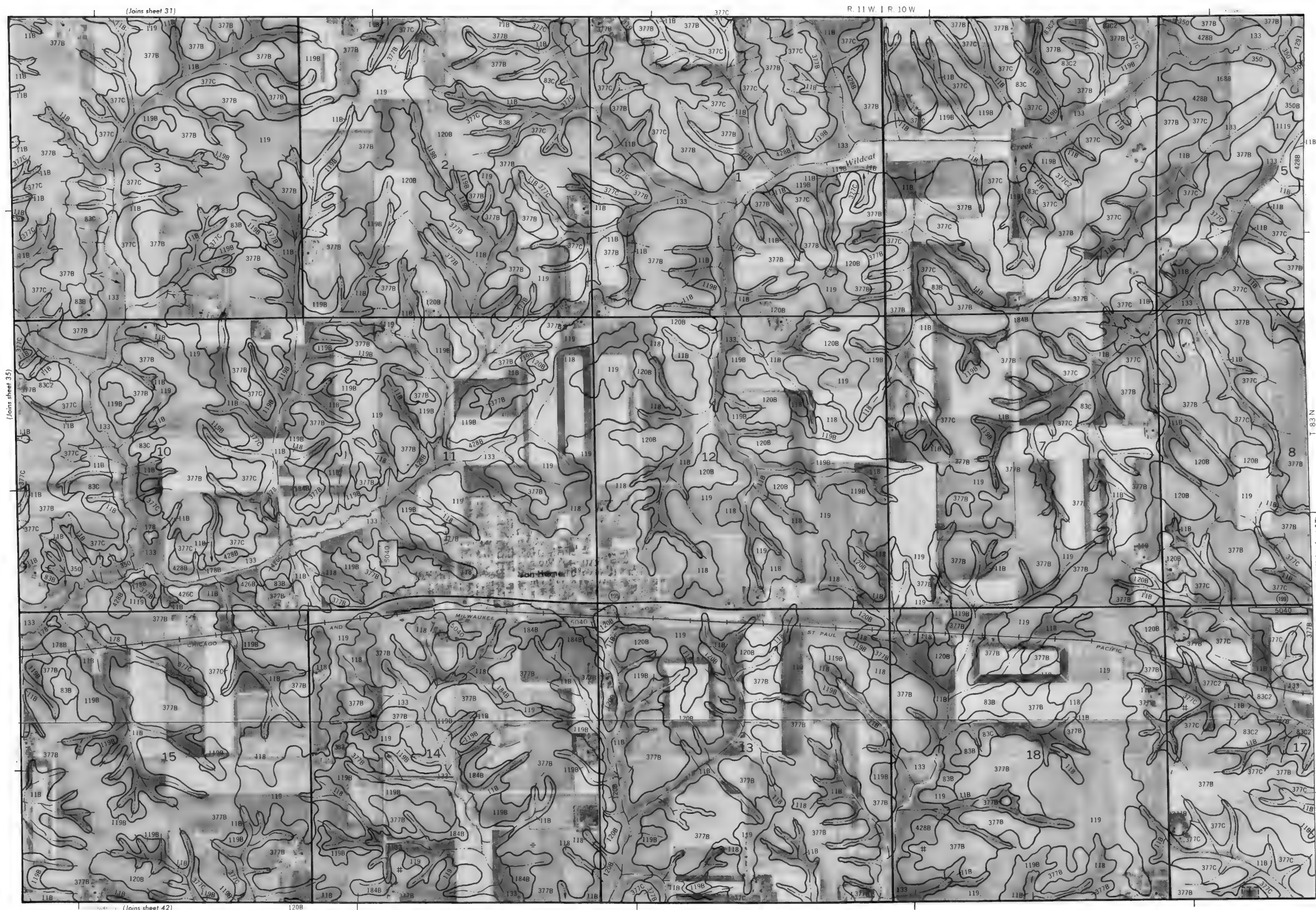
(Joins sheet 30)



Scale 1:15840

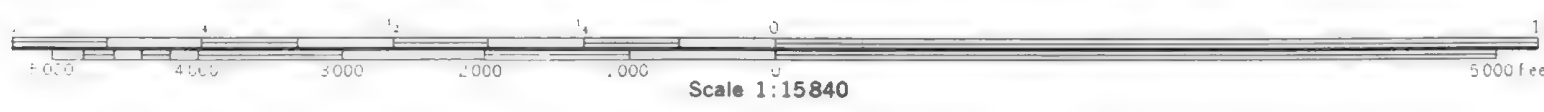
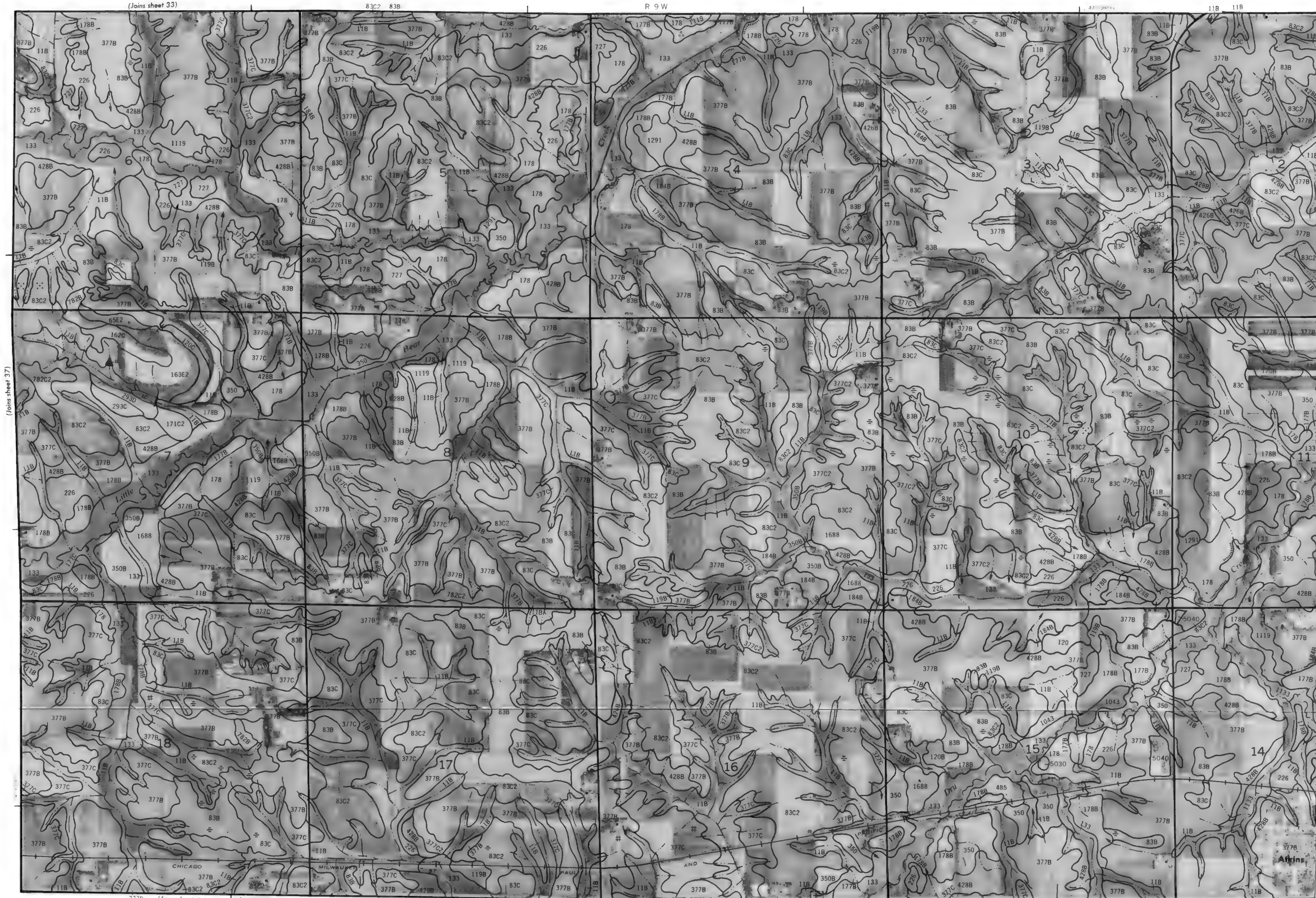


BENTON COUNTY, IOWA - SHEET NUMBER 36

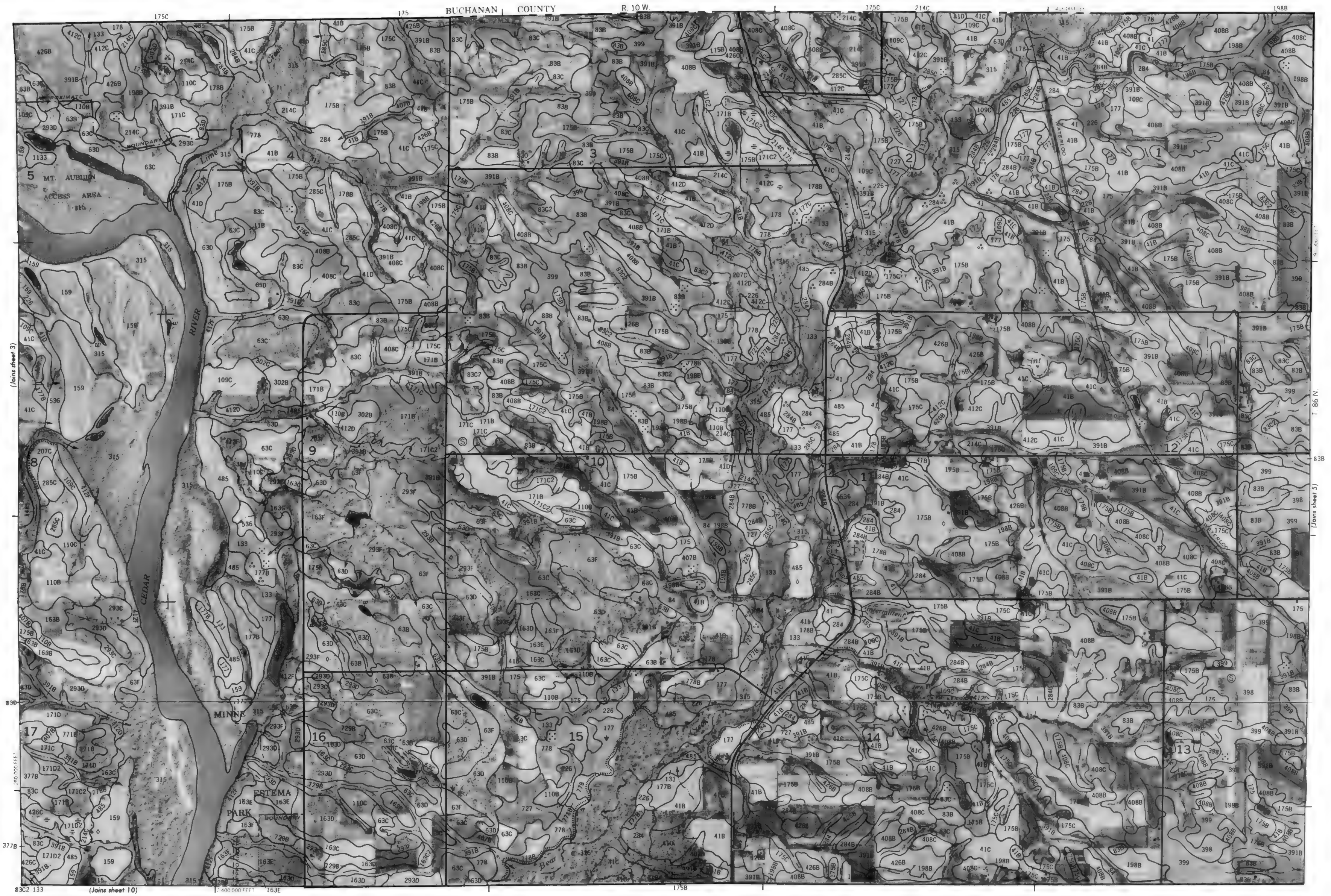




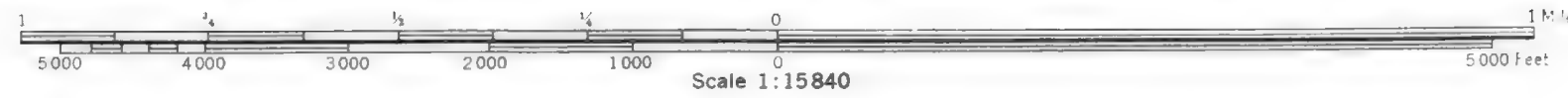
BENTON COUNTY, IOWA - SHEET NUMBER 38



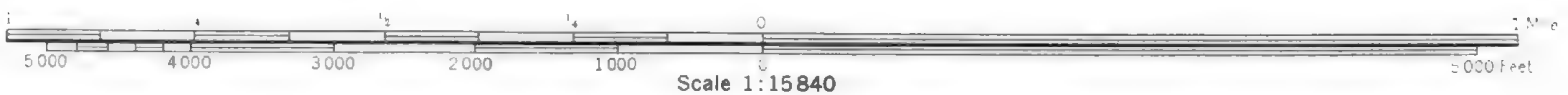
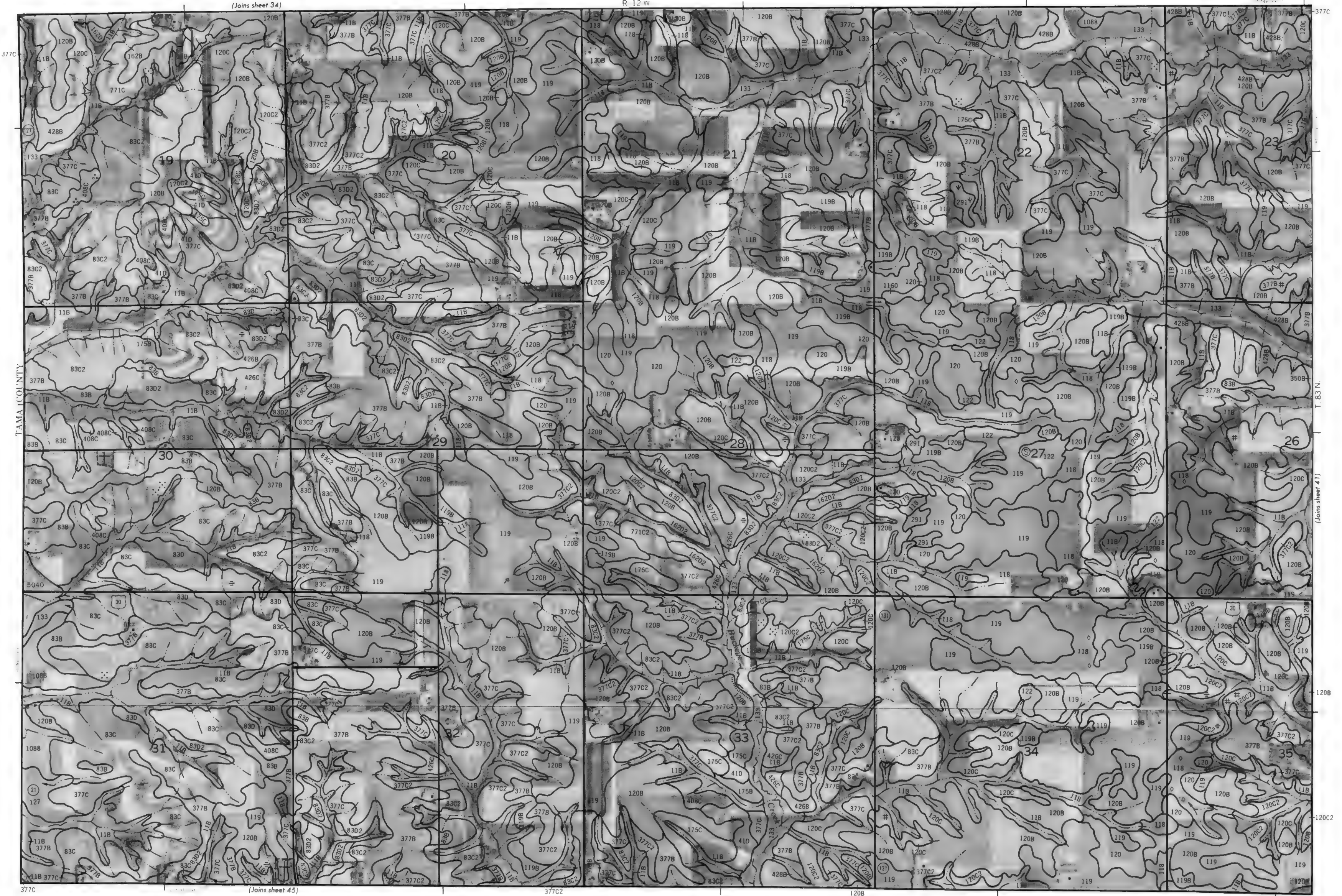
BENTON COUNTY, IOWA - SHEET NUMBER 4

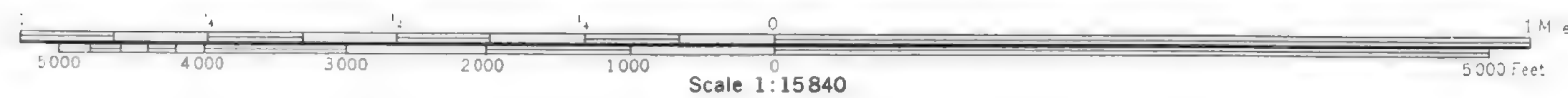


This map is compiled on 1969 aerial photographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



1:15840

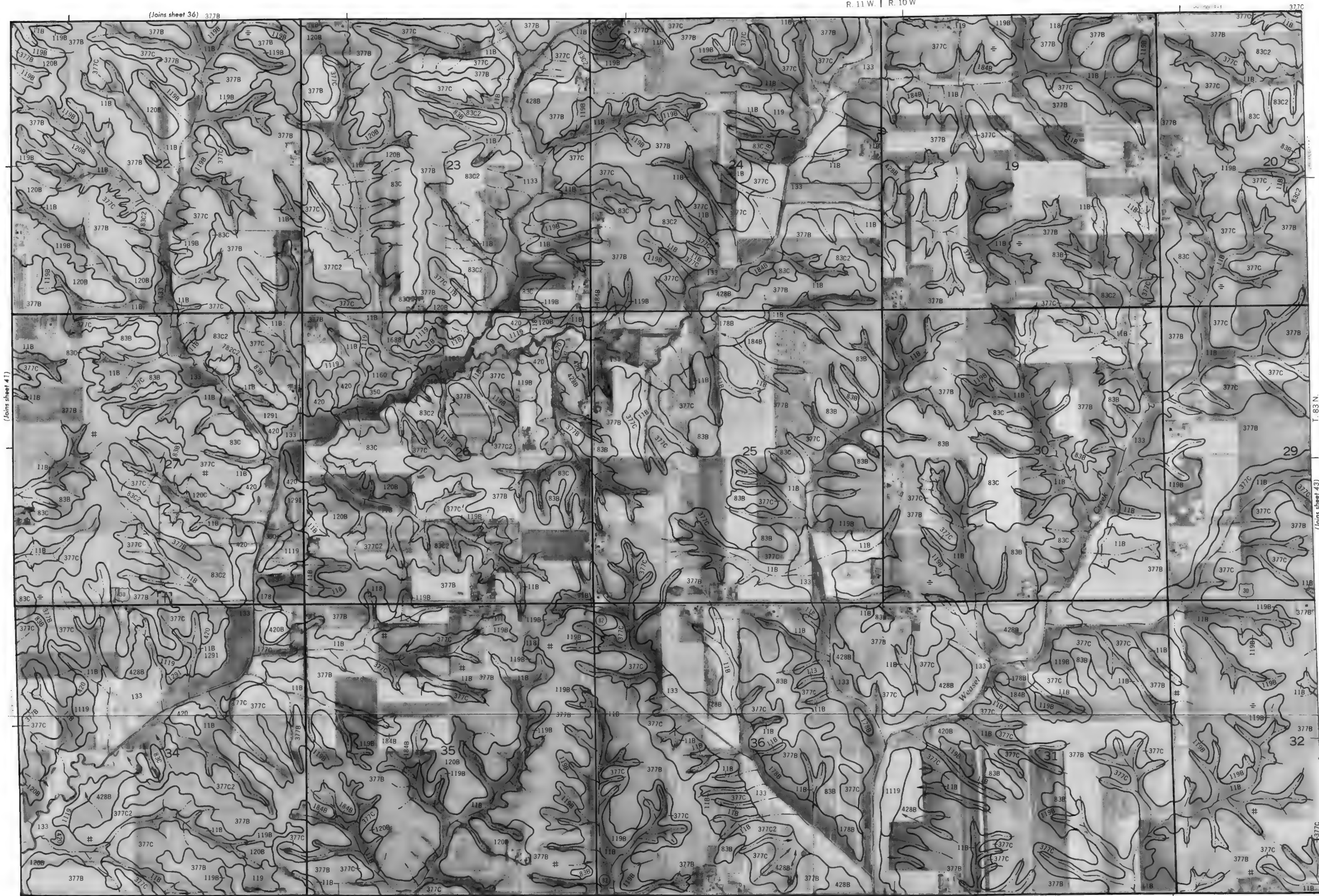




Topographic and other data
from the 1911 and 1917
censuses.

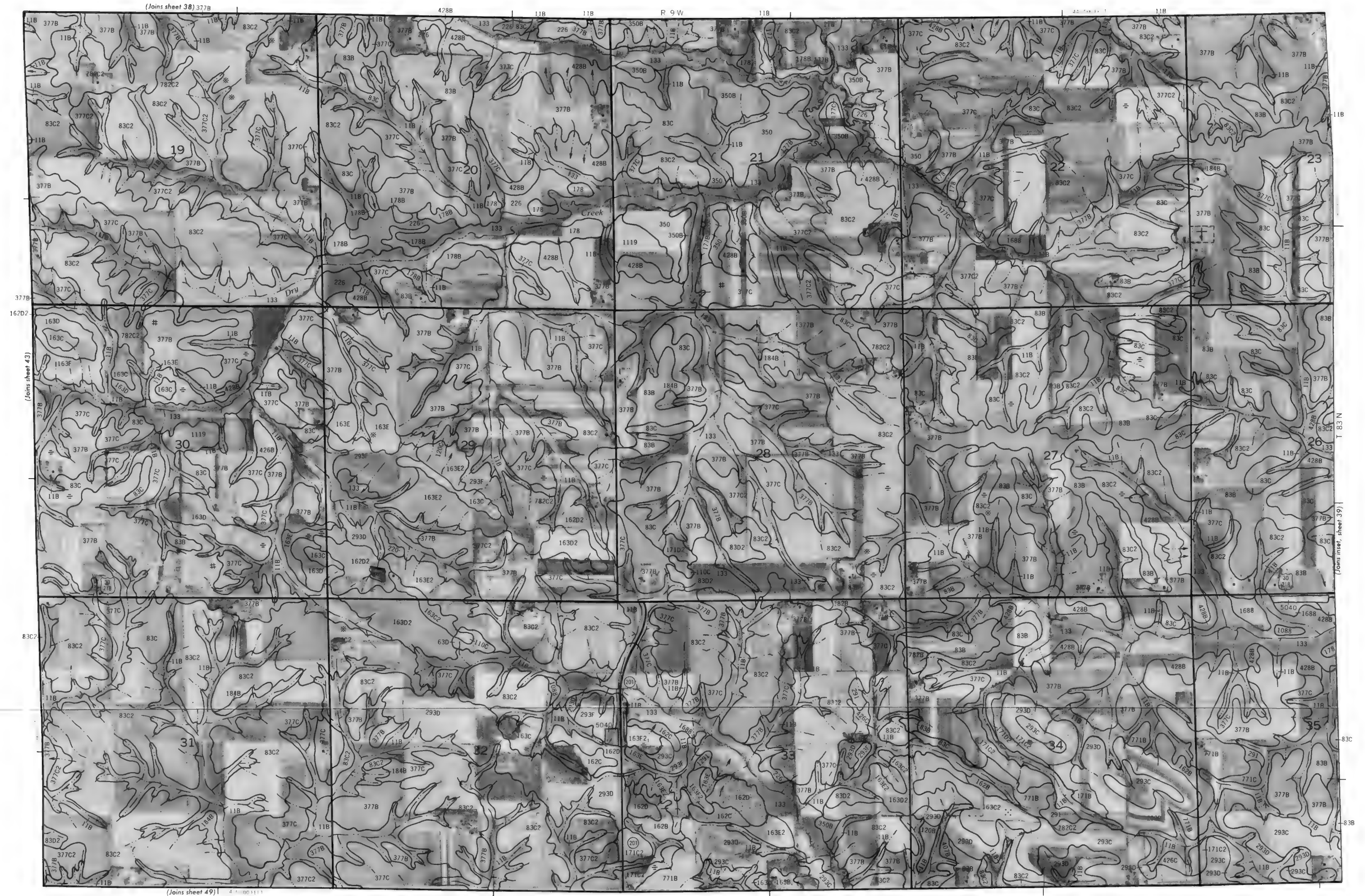


R. 11 W. | R. 10 W.



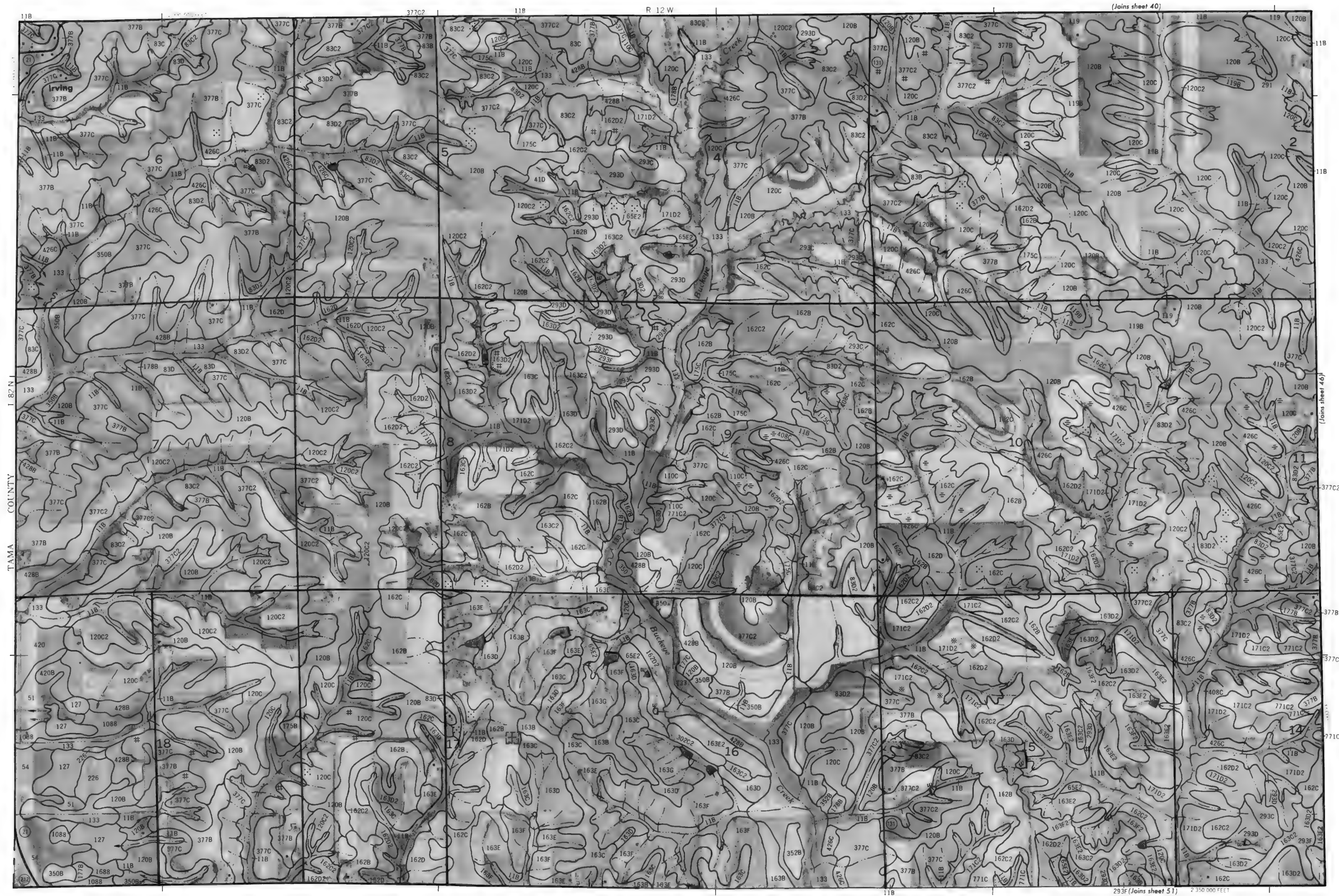


BENTON COUNTY, IOWA - SHEET NUMBER 44



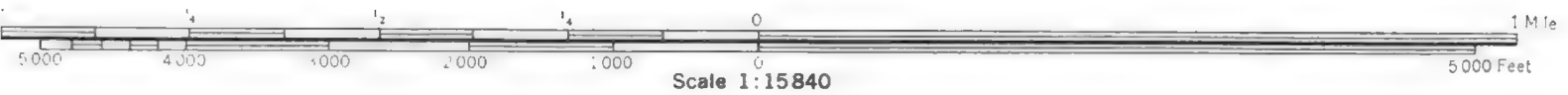
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Scale 1:15840



United States Geological Survey
Topographic Map of Benton County, Iowa



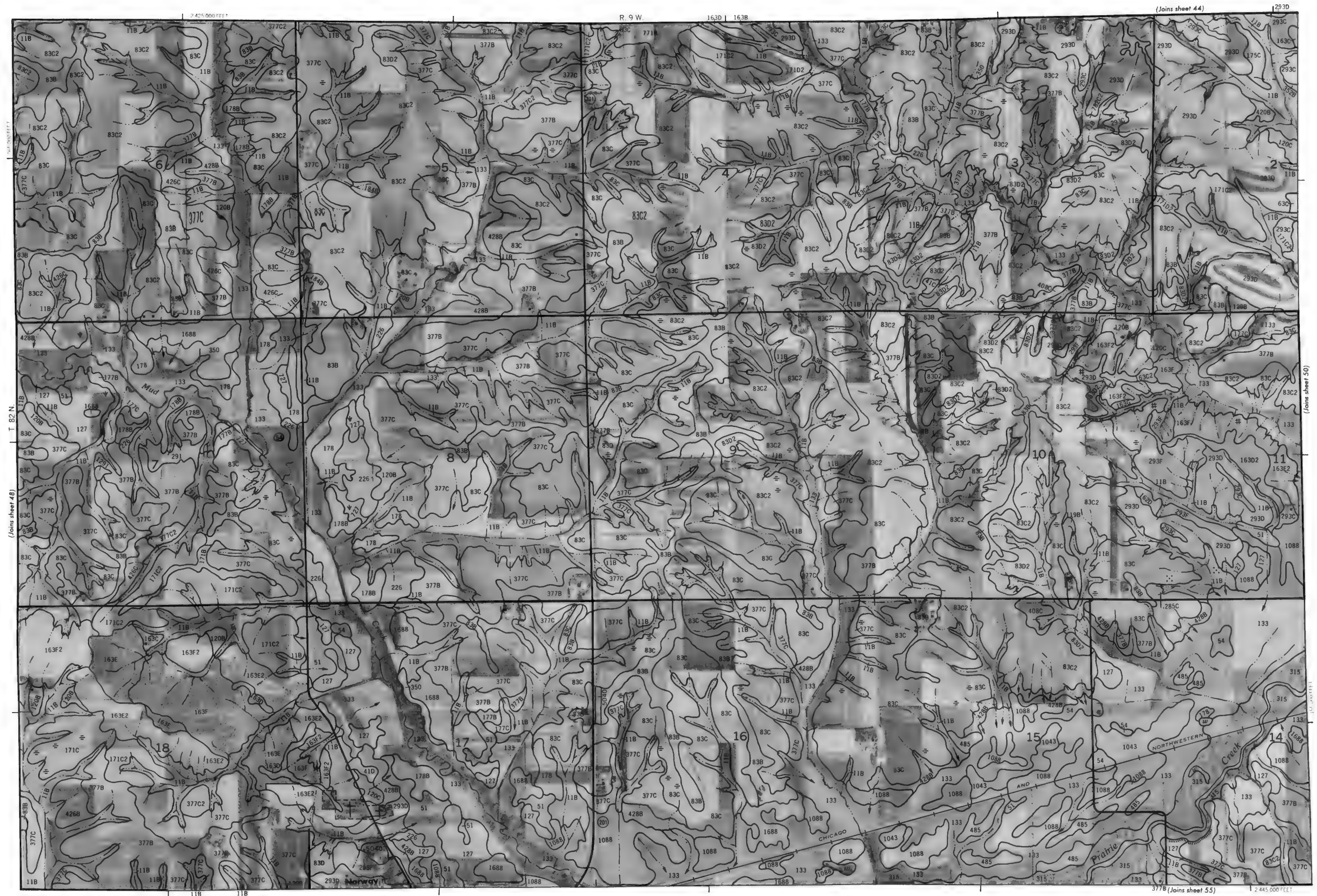


R 10 W 1 83C2



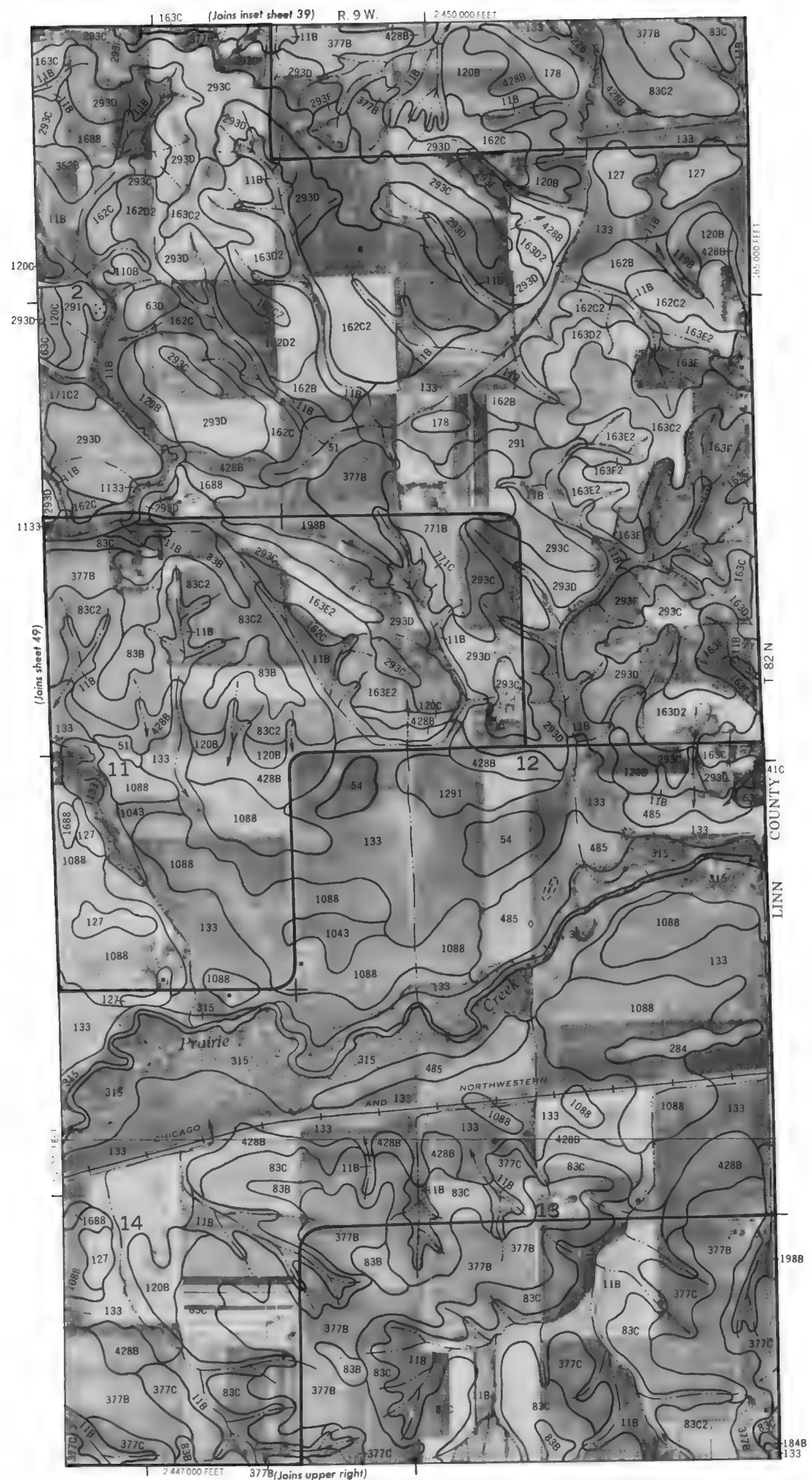
The first two steps are: (1) identifying the
 relevant data and (2) identifying the
 relevant variables and their relationships.



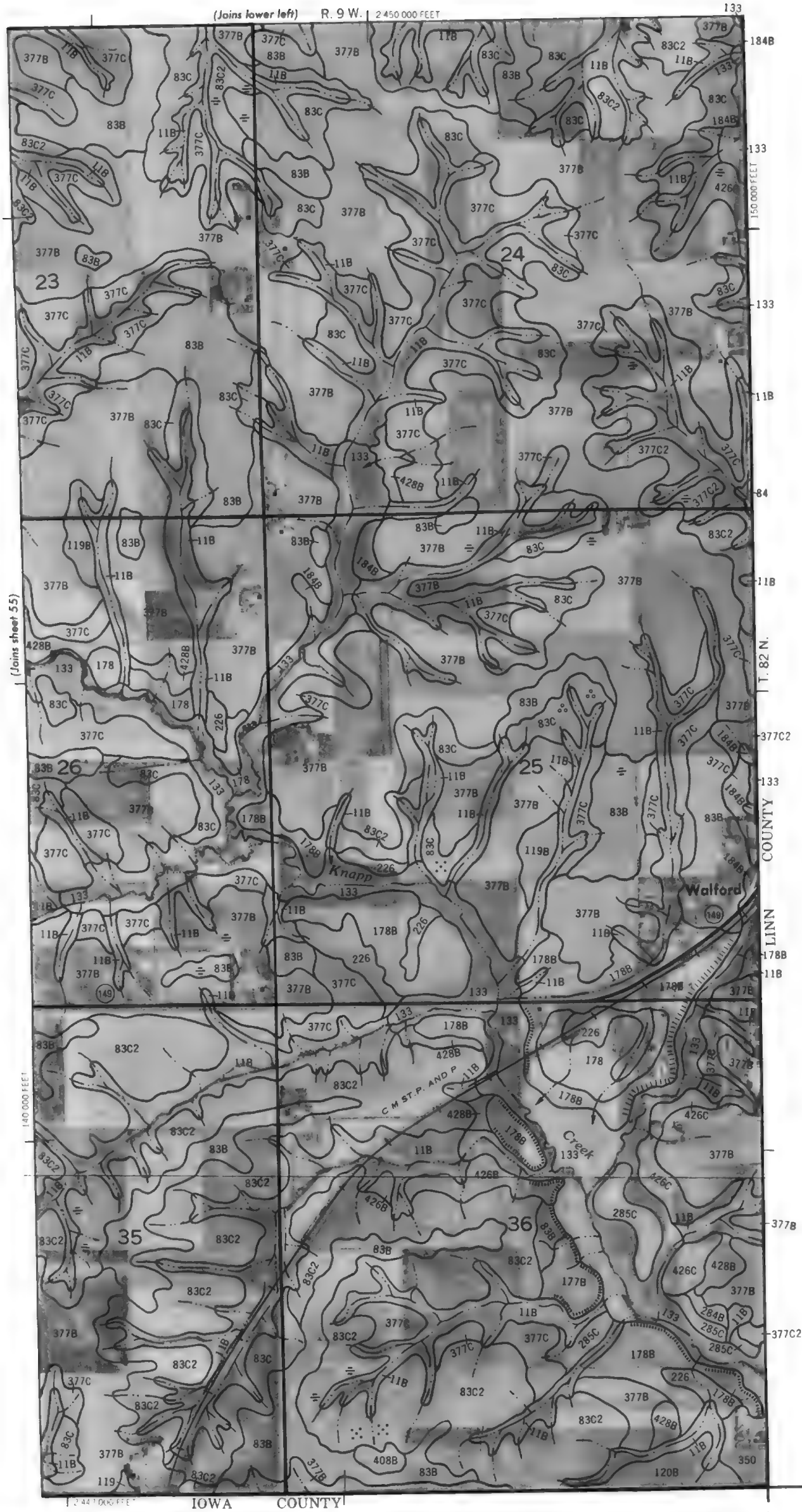
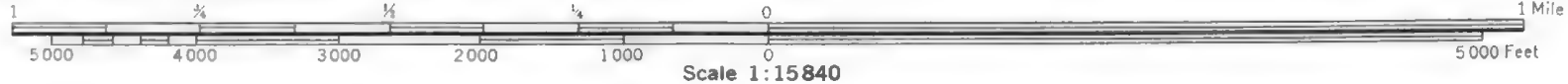




BENTON COUNTY, IOWA - SHEET NUMBER 50

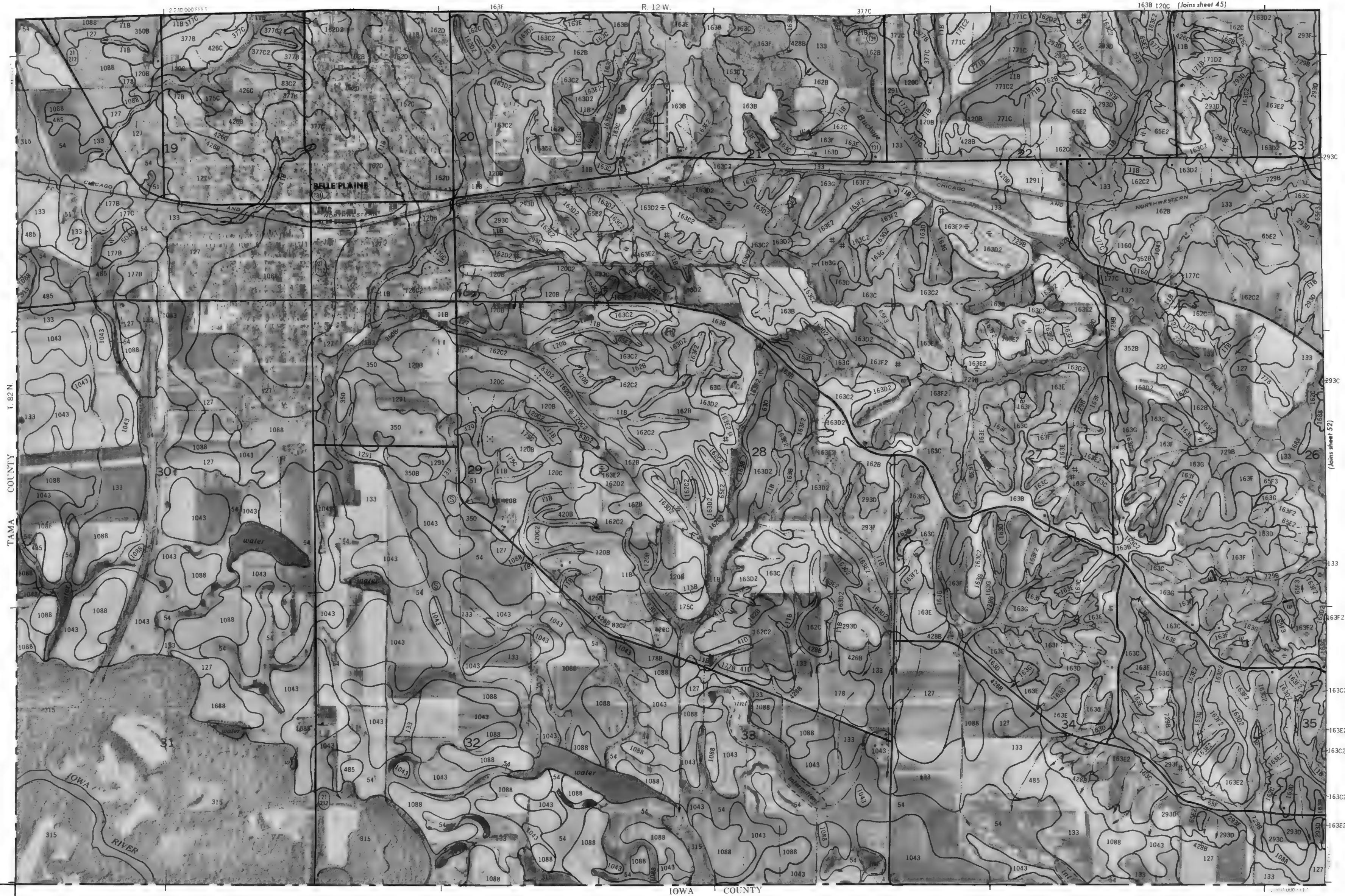


This map is compiled on '969 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

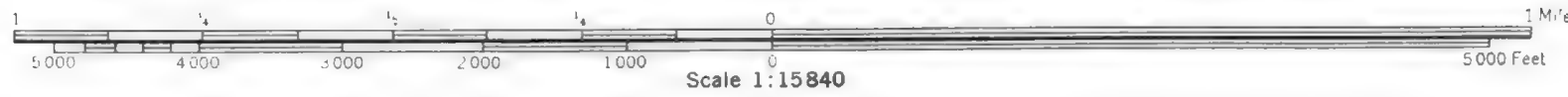


Coordinate grid ticks and land division corners are approximately positioned

BENTON COUNTY, IOWA NO. 51



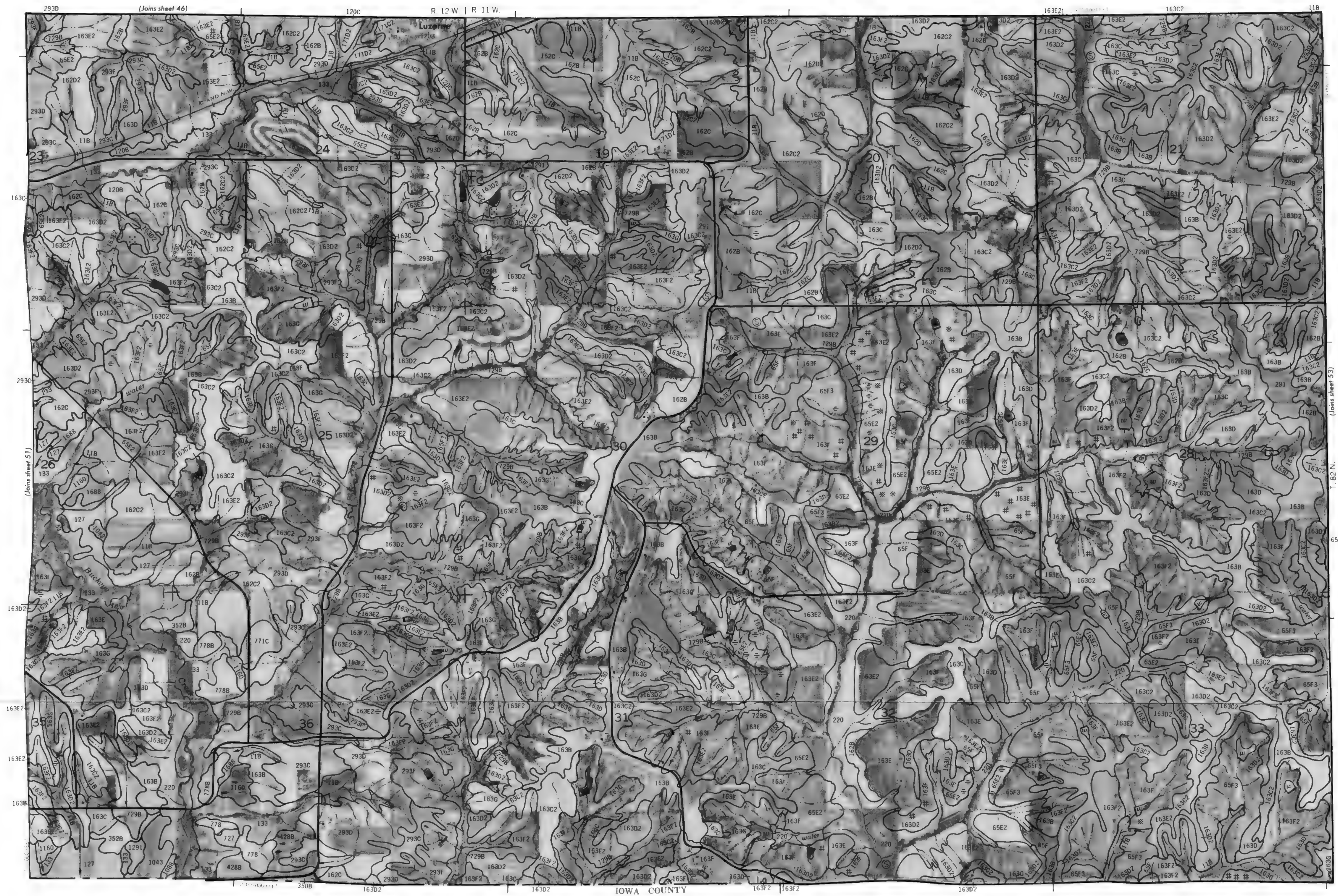
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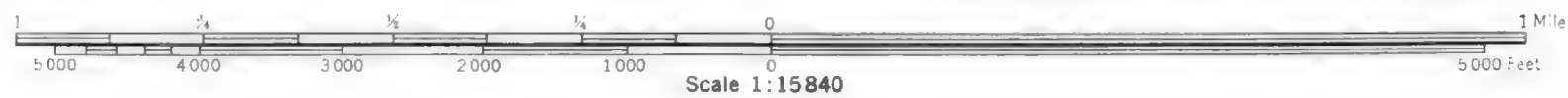
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BENTON COUNTY, IOWA - SHEET NUMBER 52



This map is compiled on 1969 aerial photography
by the U.S. Department of Agriculture. Soil
classification is by the National Soil Survey
Center, Ames, Iowa.

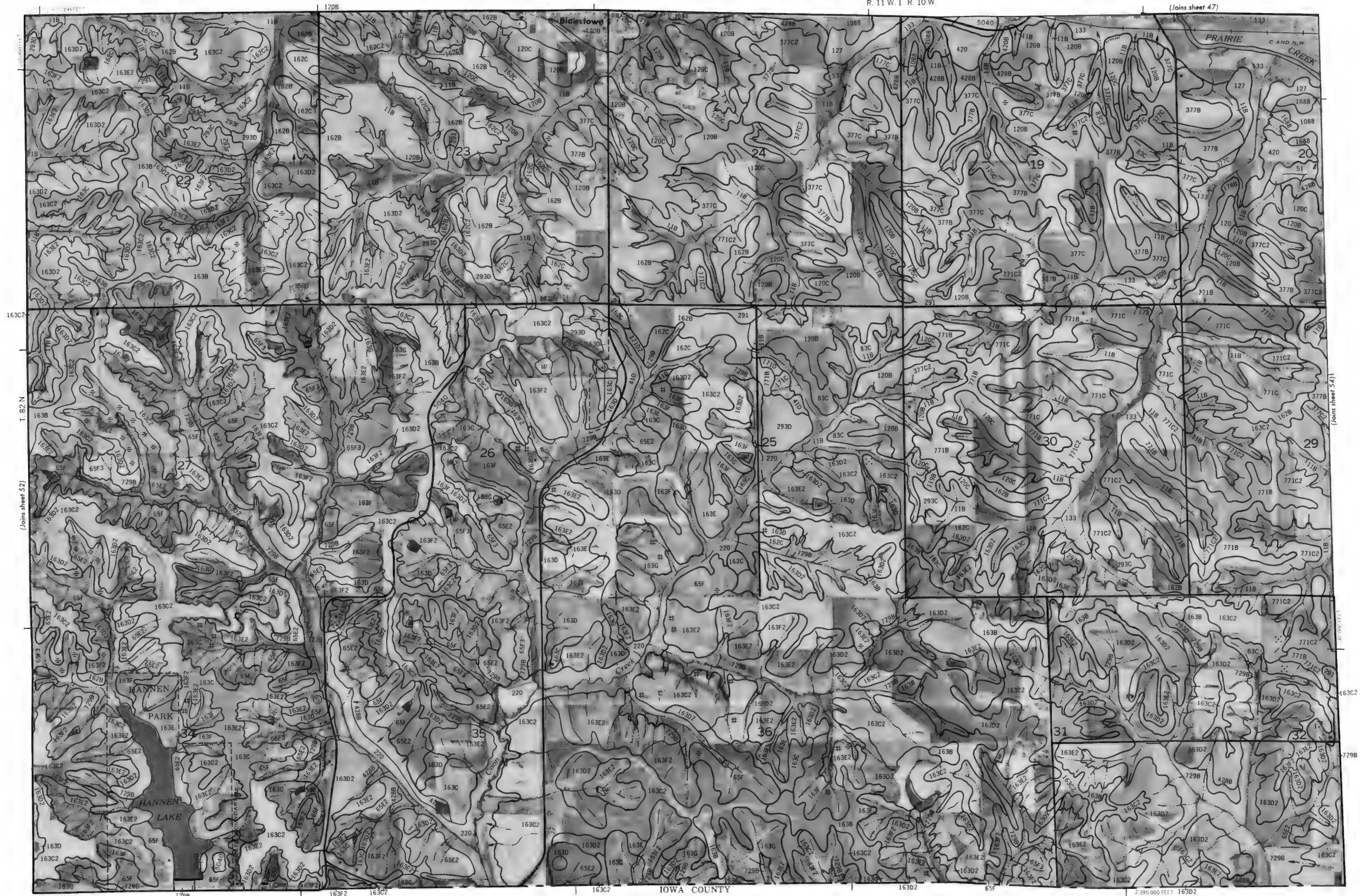


Contour interval 20 feet
Spot elevation in feet

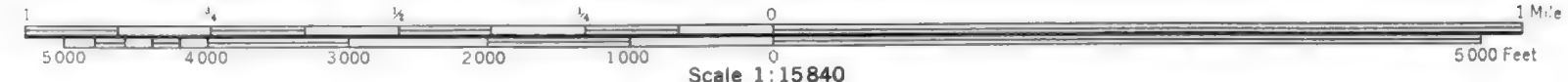


R. 11 W. | R. 10 W.

(Joins sheet 47)



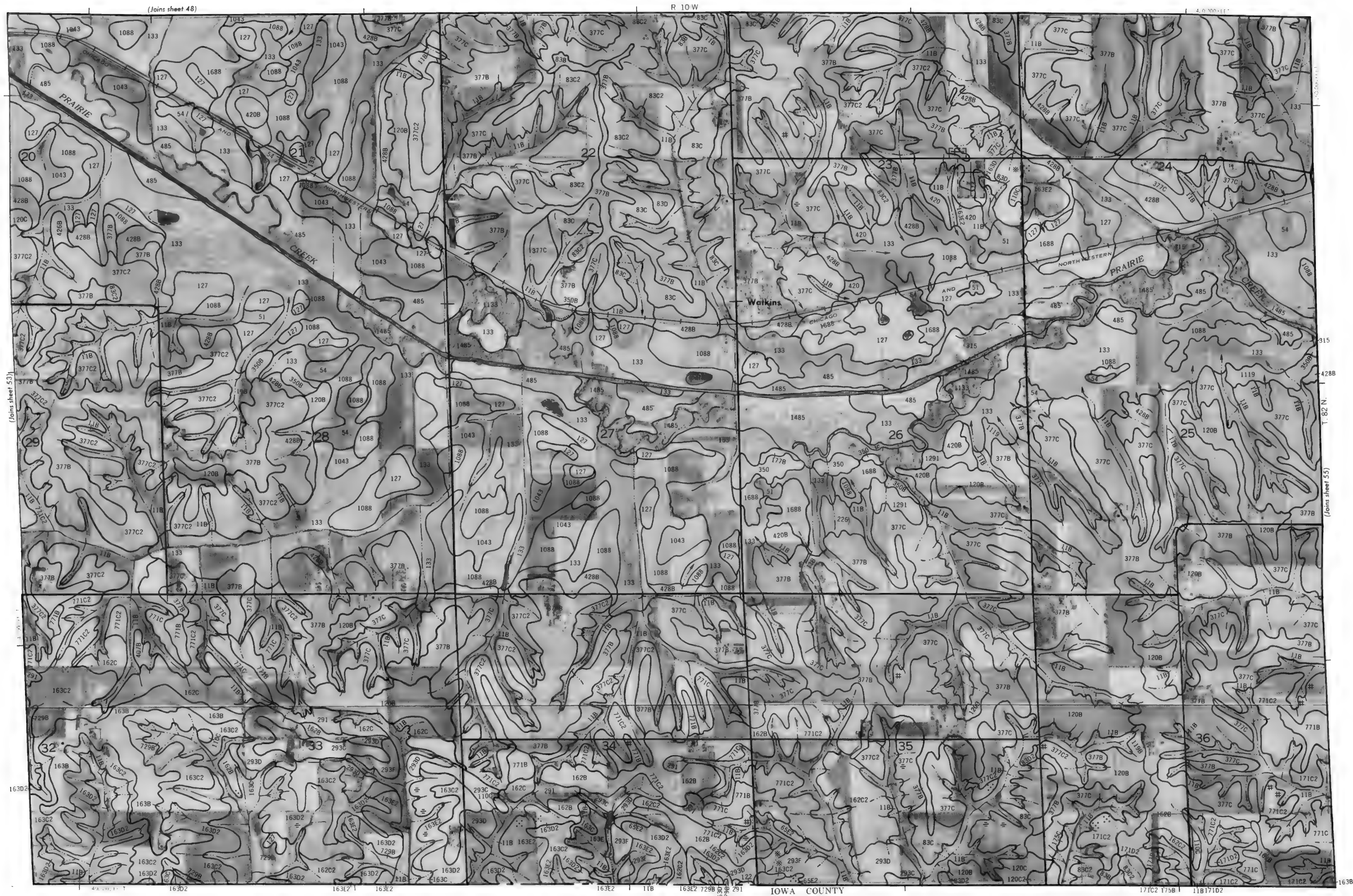
This map was prepared by the Iowa Department of Agriculture and Land Stewardship Service and cooperating agencies.



Contours and lines are approximate, printed.



BENTON COUNTY, IOWA - SHEET NUMBER 54



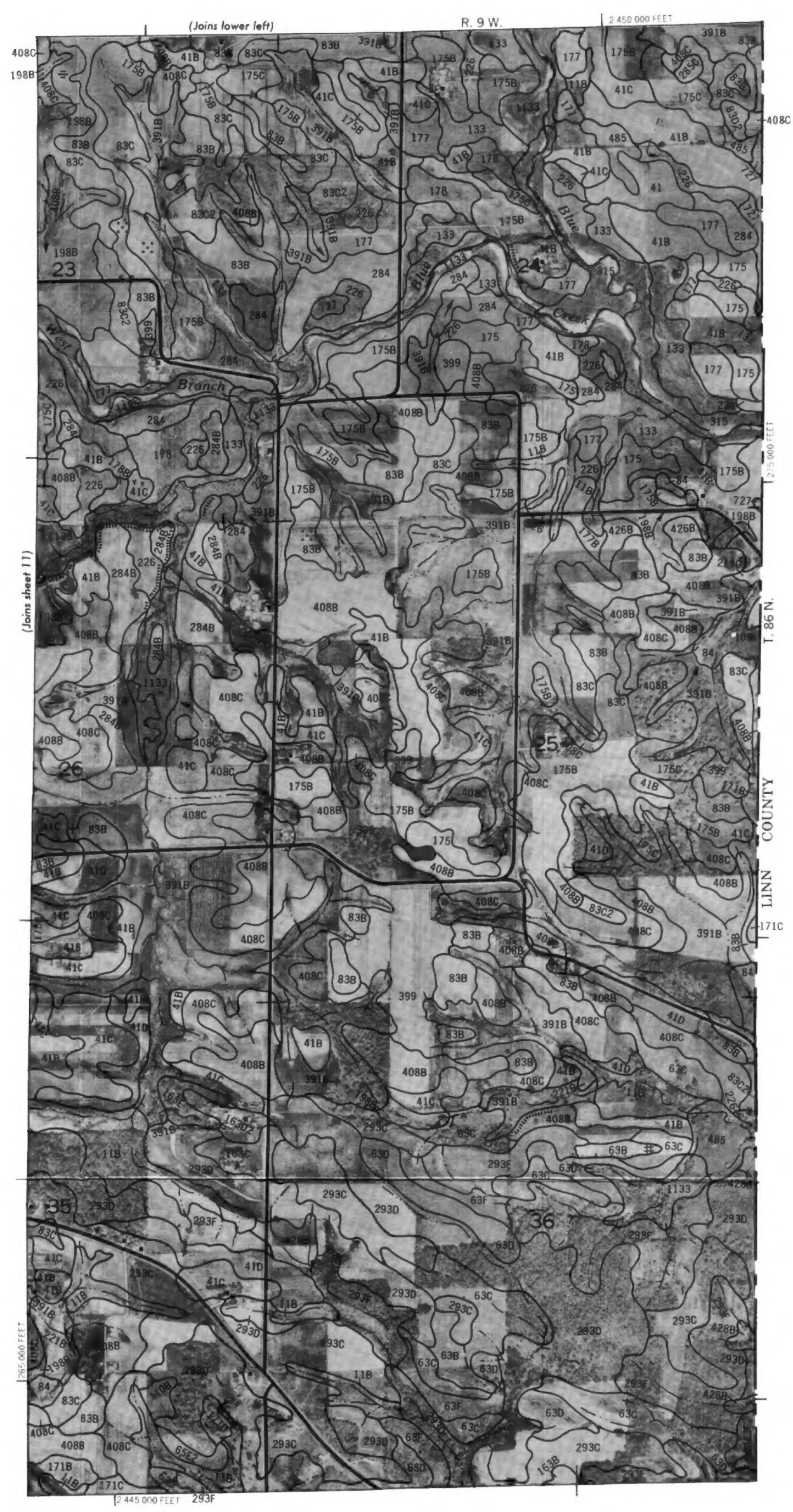
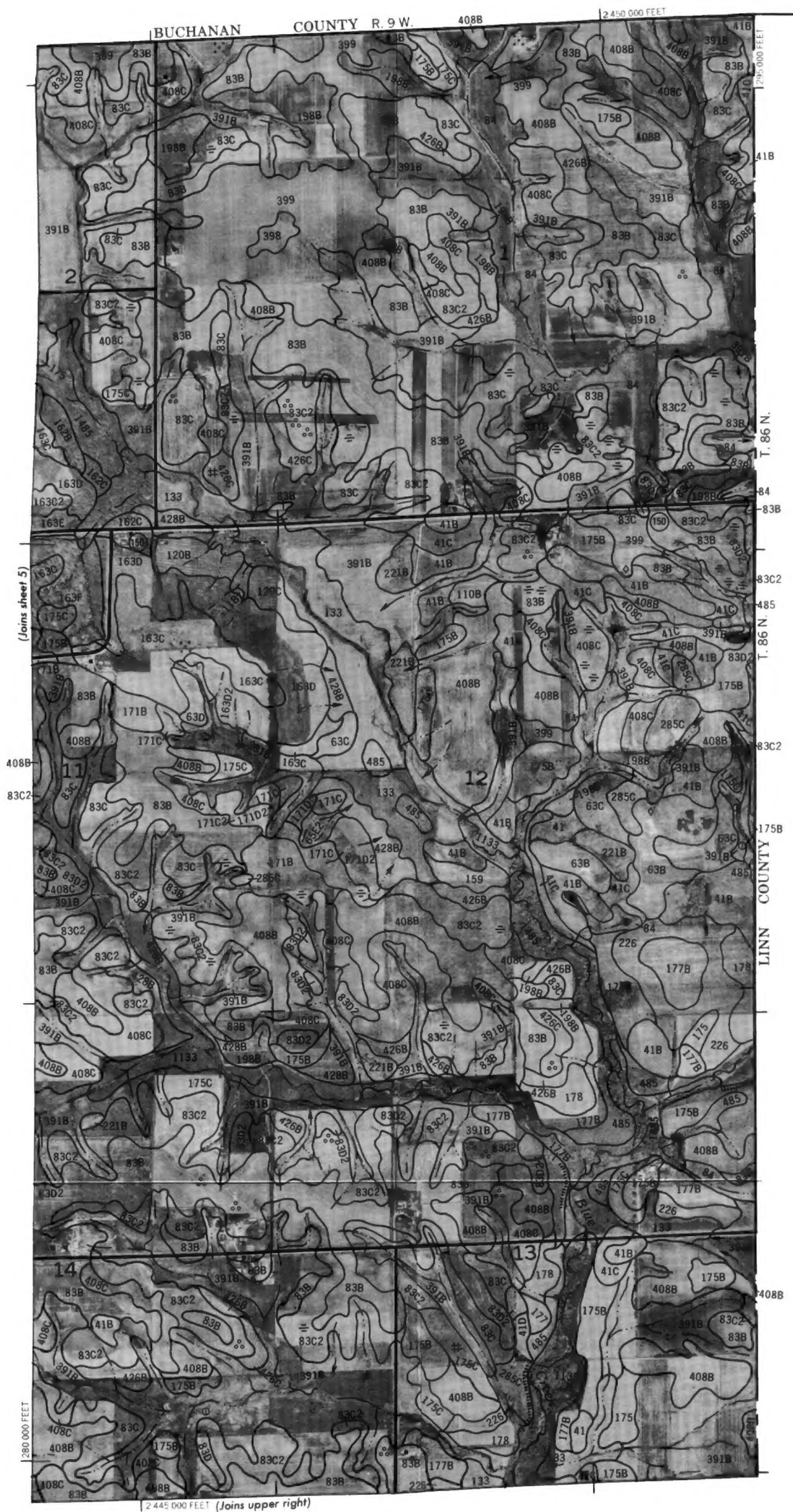


(Joins sheet 54) T. 82 N. 1

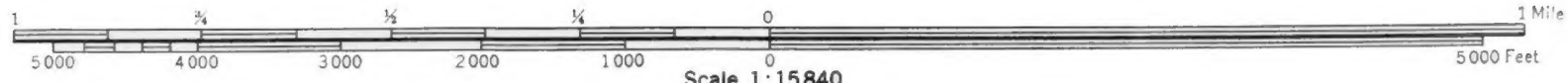
the above approximation, plotted



BENTON COUNTY, IOWA - SHEET NUMBER 6



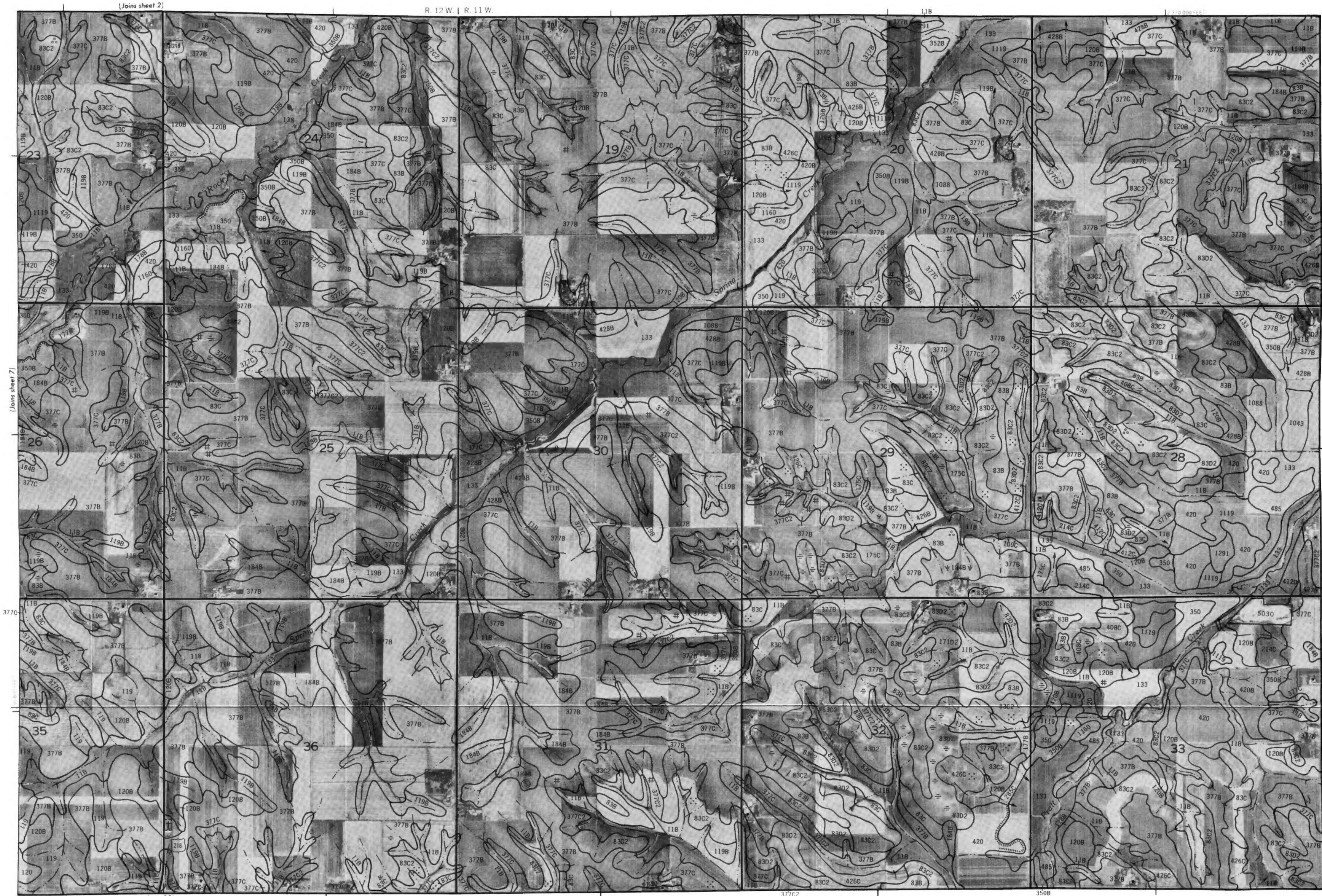
This map is compiled on 1969 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



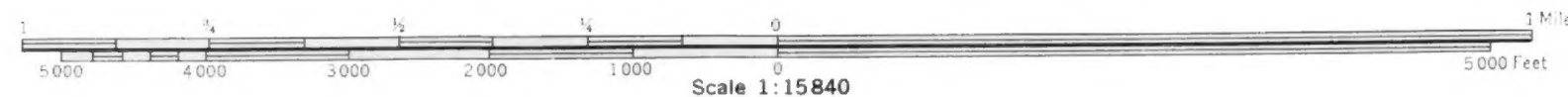
Coordinate grid ticks and land division corners are approximately positioned.



BENTON COUNTY, IOWA - SHEET NUMBER 8

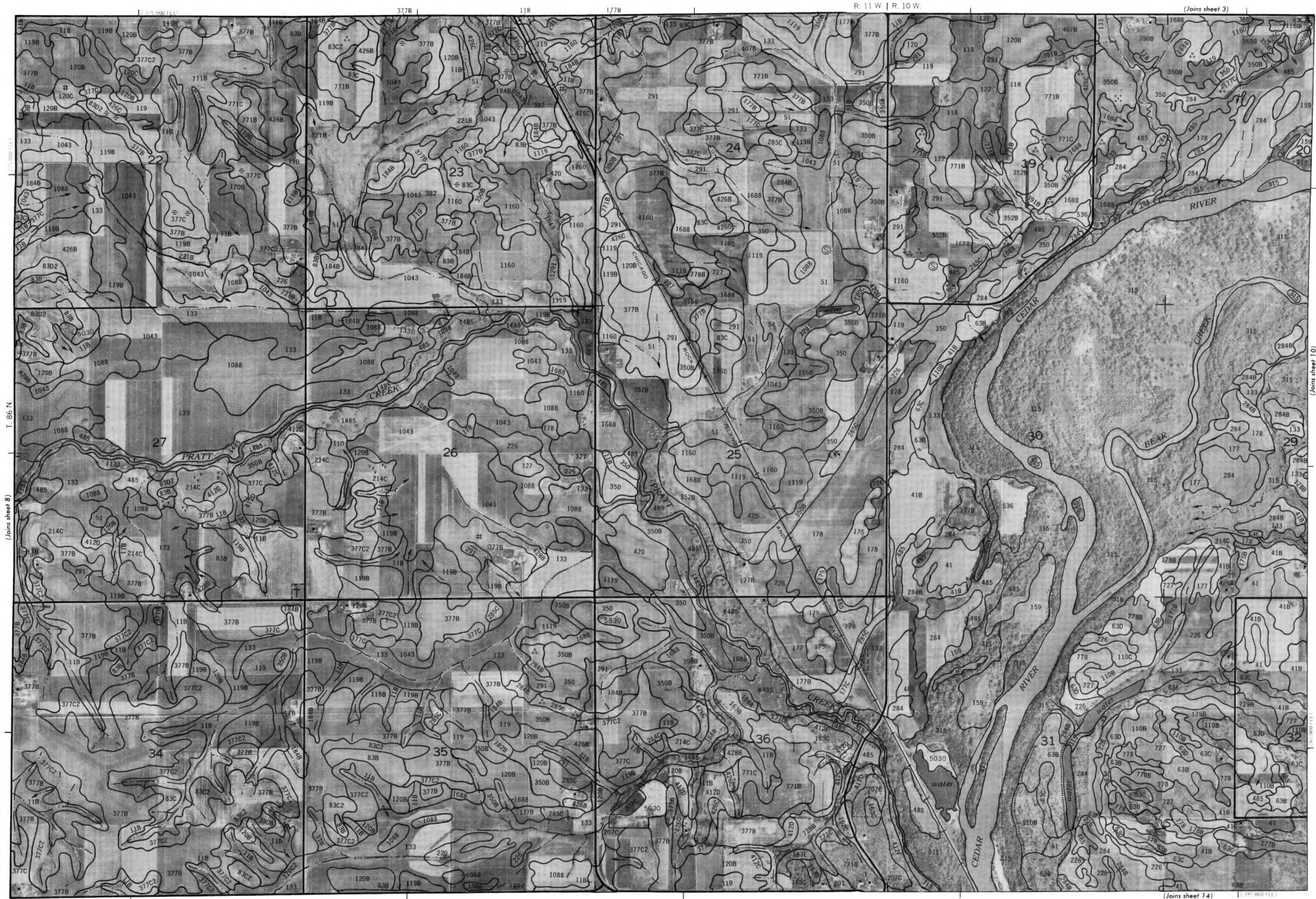


This map is compiled on 1969 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

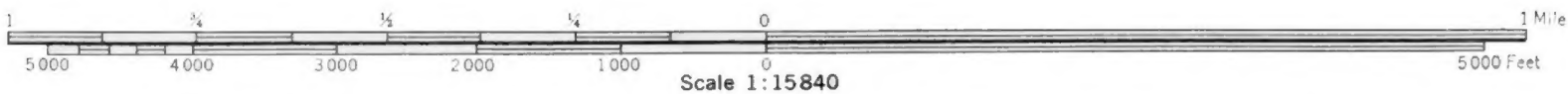


Coordinate grid lines and land division corners are approximately positioned.

BENTON COUNTY, IOWA NO. 9



This map is compiled on 1969 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



Coordinate grid ticks and land division corners are approximately positioned.